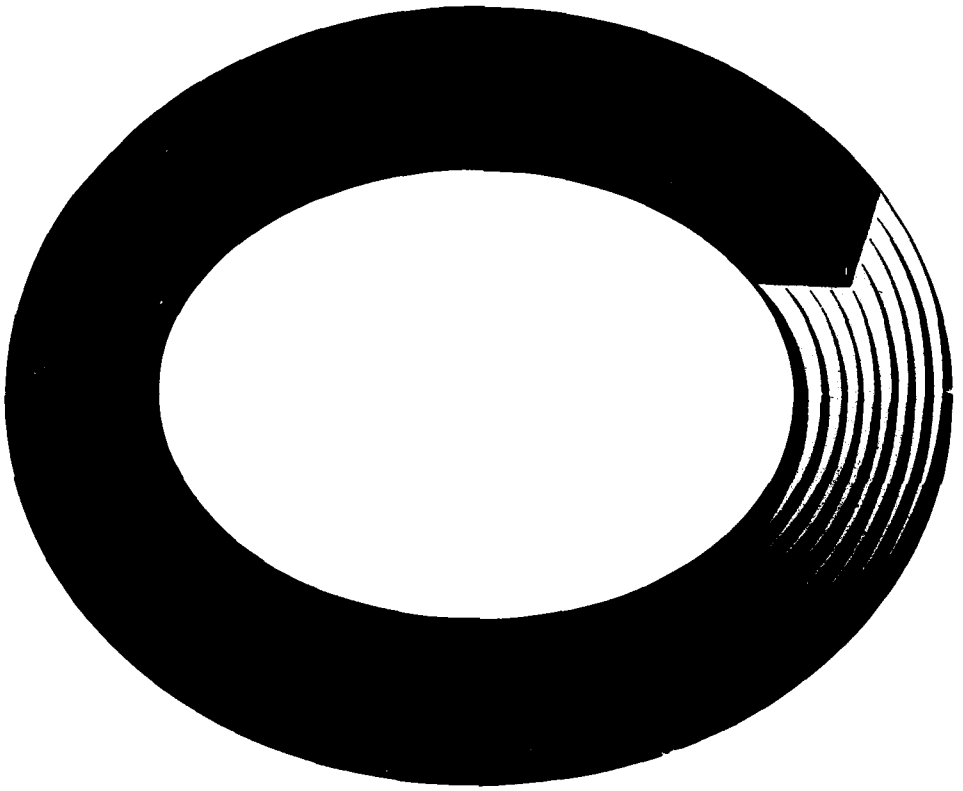
MANAGING QUALITY AND PRODUCTIVITY IN AEROSPACE AND DEFENSE

NOVEMBER 1989



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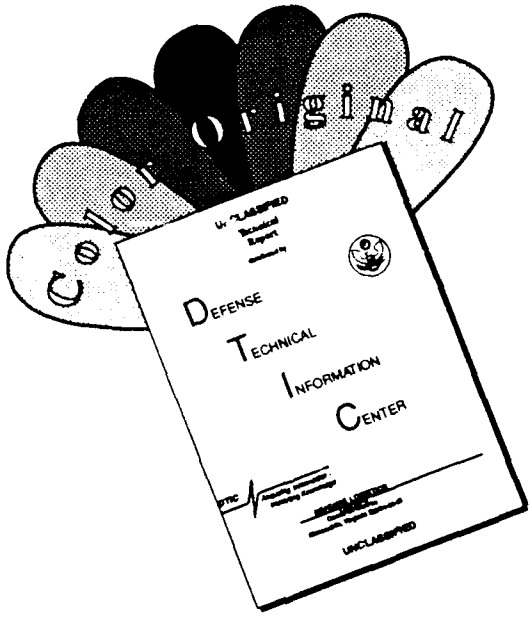

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Executive Summary

Introduction

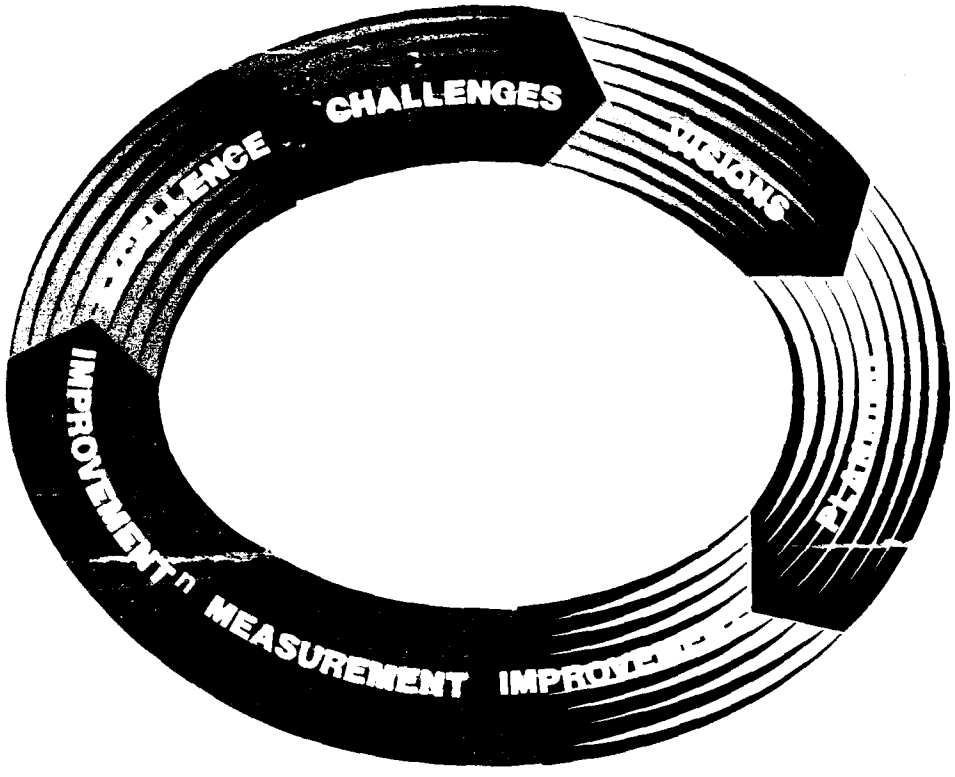
This document has been designed and developed to provide management teams and leaders in the aerospace and defense contracting community with state-of-the-art and practice concepts, theories, strategies, and techniques relative to quality and productivity management. The document is the product of a five-phase, six-year study funded by the Department of Defense (DoD). The study involved a multi-disciplinary and diverse group of aerospace and defense (A&D) contractors, academicians involved with university-based quality and productivity centers, military service acquisition elements of the DoD, and the Defense Systems Management College. This document has been closely scrutinized and edited by respected members of the Aerospace and Defense Contractor community. This is not the first document, and it won't be the last, on the subject of quality and productivity management. We do believe that for the purpose it was designed, it is one of the best and will perhaps survive the test of time better than most.

Designing and producing a defense system is complicated and always presents significant challenges. In this process, each defense contractor has a vital stake in improving the quality of its management approach – some choose to call it "total quality management" – during a defense system program. Total performance management efforts are critical in the defense systems they produce. The process involves managers and workers in an organization working in a totally integrated effort toward improving performance at every level. According to the DoD, improved performance is directed at satisfying cross-functional efforts such as quality, cost, schedule, manpower development, product development, and productivity. These activities, of course, must be focused ultimately on increased customer/user satisfaction.

The environment (internal and external) of the defense contractor is extremely complex, dynamic, and competitive. The challenges facing management and leadership in an A&D organization are, in many respects, far greater than those facing managers and leaders in similar commercial enterprises. There are constraints and contingencies to anticipate, few of which are controllable. The situations are often "Catch-22" in character. The reality of an A&D organization makes quality and productivity management even more difficult and certainly different than it is in the commercial, private or public sector.

With this in mind, we hope that this document will serve as a catalyst or a "roadmap" for you to continue to build on excellence. We believe that this document, if studied carefully by a management team, can assist in the development of strategies and tactics to improve quality, productivity, and overall performance. We are not suggesting you "copy" what is suggested herein: we encourage your management team to be "chefs," not "cooks."

This document reflects exemplary approaches and techniques being developed, practiced, and continuously improved upon in the world today. In the face of seemingly insurmountable day to day pressures, the A&D organization's leadership and management teams must continue to strive to be the "best of the best" in a global economy. When the defense contractor wins, the government also wins. Creating improved win-win situations is central to this document.


CHALLENGES
VISIONS
IMPROVEMENT
MEASUREMENT

Executive Summary

About this Document

The challenge we face today causes us to reflect on how we will need to perform in the future. This future state or vision is a new model of the organization of the future. To make this vision a reality, we must plan for performance improvement and effectively implement those plans. The resulting improvement provides an impetus to measure improvement. You cannot manage what you cannot measure, and you can't measure what you can't operationally define. Improvement-oriented measurement then leads to further improvement that leads to excellence – that is, actually achieving the vision one set out to accomplish. The process is a true circle, repeating itself through all phases again and again to achieve continuous performance improvement. It never stops.

This document begins with an attempt to reflect on the **challenges** facing the A&D Contractor. This is a must chapter for all members of your management team.

The second chapter focuses on **visions**. We compare and contrast the organization of the present with visions of the organization of the future. We present a "roadmap for change," leading from guiding principles to visions to management processes to effective implementation. This is also a must read chapter.

The document then turns attention to an innovative and effective way to strategically plan for performance improvement. A state-of-the-art **planning** process, designed to operationalize the "roadmap for change" presented in Chapter 2, is outlined in some detail in this third chapter. This process is tried and tested, and deserves attention from your management team, particularly those involved in strategic planning.

The fourth chapter focuses on the bottom line, **improvement**, based on a conceptual overview of present, emerging, and future strategies and techniques. The chapter concentrates on three critical areas: (1) Total Quality Management, (2) Management of Participation, and (3) Reward Systems. Planning and measurement systems merit their own chapters (Chapters 3 and 5 respectively). It is our belief that an organization successfully doing the things talked about in this document would, in fact, be managing total quality. This alone should spark study of this document. This study began as "The Study of Productivity Measurement and Incentive Methodology." As such, the reward systems section of this chapter is fairly detailed. The measurement chapter, Chapter 5, is therefore, also substantially detailed.

Chapter 5, **measurement**, begins with concepts, operational definitions, and design development guidelines and evolves to a process for developing measurement systems. The process presented is equally valid for and applicable to "white collar" as well as direct labor measurement. The chapter ends with some detail on specific state-of-the-art techniques for measurement. The chapter details a critical, and sometimes troublesome area, and represents a major thrust of the study. Everyone in your management team should read the early portions of the chapter; perhaps only your "measurement masters" will need the whole chapter.

Executive Summary

We struggled with a one-word description of the sixth chapter. Originally, it was titled "improvement," but many felt that this was confusing, since it was also the Chapter 4 title. The concept addressed in Chapter 6 is continuous improvement. We finally arrived at the title **improvement^n** (improvement to the nth power), which is somewhat abstract, but we felt it was descriptive and would perhaps capture the attention of your management team.

The final chapter, seven, is our capstone. It addresses the issue of **maintaining excellence** and presents quotes from a variety of successful leaders on the subject of excellence. We hope they will be of value to your management team. The chapter ends with a roadmap for change.

Following the final chapter is an appendix containing example output from planning sessions, a detailed bibliography and list of references, a subject index, a history of the project, and a list of our government and industry advisory board.

We believe this document goes beyond such works as *In Search for and Passion for Excellence, The Change Masters, Megatrends, Out of the Crisis, Quality is Free, Competitive Strategy, and World Class Manufacturing*. This is not to imply that it is superior to these classics; it implies that this document takes the reader a step closer to operationalizing the concepts presented in these books. This document is available from: the Government Printing Office, LTV Aircraft Products Group, The VPC at Virginia Tech, The Maryland Center for Productivity and Quality of Worklife at the University of Maryland, and Price Waterhouse.

Please feel free to provide us with feedback. We hope you will read and study this document, and apply single-ideas or whole concepts.

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November 1989

This document is the product of over six years of investigation into productivity measurement, gainsharing/incentive methodology, quality and productivity management theory, and techniques and processes in the Aerospace and Defense Community. The evolution of this project and this, its final product, are described in Appendix C.

The purpose of this project, from its conception, was to study and capture state-of-the-art and practice theory and techniques for performance management. The target industry being studied was Aerospace and Defense (A&D) Contractors, but along the way we discovered that excellent A&D organizations are excellent organizations in general. There are tremendous differences between an A&D Contractor's world, and the commercial world. Yet it is our conclusion that valuable lessons can be learned from our findings. Although we have captured how the best are and will be managing quality and productivity in Aerospace and Defense organizations, the concepts, processes, approaches, and techniques presented will be valuable in the commercial arenas as well.

The project began in 1980 as "The Study of Productivity Measurement and Incentive Methodology." It has evolved substantially and has resulted in a superior document describing an approach to quality and productivity management. I stress the words "an approach" because we are not suggesting that the overall approach and strategies, or even the specific techniques covered, are the only way to manage quality and productivity. Our study of excellent organizations revealed, in general, the approaches, strategies, and techniques documented in this publication. There isn't an organization we studied that is managing quality and productivity exactly the way we describe it here. However, if we were to develop a profile of the quality and productivity management approaches, strategies and techniques for a hypothetical, "average," excellent A&D organization, that profile might look very much like what we have described in this document. We suggest that the excellent A&D organization, or any industrial organization for that matter, will, in the future, be managing quality and productivity in very much the fashion we have described in this document.

I have used the word "we" a number of times in the last paragraph because this document is the product of contributions by many people and organizations over the years. This project has been a team effort of the A&D industry, the DoD, and academia. I have listed members of the project team below; however, certain acknowledgements deserve more than a simple listing.

Dr. Richard Stimson, previously Director of Industrial Productivity in the office of the Secretary of Defense, and now with Emhart: Advanced Technology, along with Mr. Monte Norton and Mr. Wayne Zabel of the Army Procurement Research Office were, to my recollection, the "founding fathers" of this project. They had a vision that something needed to be done in this area, and I hope we have achieved, in some measure, that vision with this document. Mr. Norton, and his associates completed Phase I of this five phase project in 1981. Dr. Thomas C. Tuttle, Director of the Maryland Center for Productivity and Quality of Working Life, became the Co-Principal Investigator with me on Phase II and has been an invaluable team member throughout the rest of the project. Mr. Richard Engwall, Westinghouse, served as our Government Industry Advisory Board Chairperson through Phases II-V. His networking capabilities in the Industry have been extremely important in ensuring that this document reflects A&D Industry reality.

Mr. Shoni Dhir, LTV, has been our advocate, a conceptual leader, and, most importantly, has provided us with a field site to better understand the A&D world. Although, over the span of the project, we studied many organizations (Boeing, Honeywell, General Dynamics, McDonnell Douglas, General Electric, Sundstrand, IBM, Westinghouse, Rockwell, and others) in a variety of ways, and involved many in our government-industry review board (see Appendix D), the opportunity to visit LTV Aircraft Products Groups and tour the facilities, talk to managers, and see, close-up, the world of A&D, has been vital to our success. The commitment of LTVAPG to this project and their support in printing the final document is much appreciated.

Professor David Acker, Defense Systems Management College, was an advisor on Phase I and II of the project, and has been our Contracting Officer's Representative for Phases III-V. He has done a superb job skillfully ensuring progress.

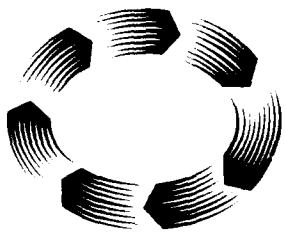
Mr. Kurt Greene, OSD, has done an excellent job in carrying on the project following the retirement of Dr. Stimson and Mr. Doug Reeves in the Office of Industrial Productivity at the Pentagon.

One final special acknowledgement goes out to Mr. Paul Rossler, project manager at the VPC at Virginia Tech. He has done the bulk of the writing, editing (with the assistance of Mr. Eric Pappas), and project managing for the past three years. The product speaks well of his contributions.

It is not possible to identify every contribution. Listed below are the key members of this project team over the past six years. I apologize, in advance, for any oversight I may have made.

D. Scott Sink, VPC at Virginia Tech
Principal Investigator, (Phases II-V)

Project Team Members	Roles	Phases
Dr Richard Stimson, OSD Industrial Productivity Office Advanced Technology	Originator, Advisor TCOR	I-V 1980-88
Professor David Acker, Defense Systems Management College	Contracting Officer's Representative for Phases III-IV, Advisor	I-V 1980-88
Dr Thomas C. Tuttle, University of Maryland, MCPQWL	Advisor, Co-Principal Investigator for Phase II; Subcontractor for Phases III-V	II-V 1982-88
Mr Richard Engwall, Westinghouse Electric Corporation	A&D Industry Advisory Board Chairman, Subcontractor Phase III, Advisor	II-V 1982-88
Mr Shoni Dhir, LTV	Subcontractor for Phases III-V	III-V, 1984-88
Mr Douglas Reeves, OSD Industrial Productivity Office	DoD, Industrial Productivity Support Office (retired)	III-IV, 1985-87
Mr Kurt Grimm, OSD Industrial Productivity Support Office	Project Oversight	IV-V, 1986-88
Mr Monte Norton, Army Procurement Research Office	Principal Investigator, Phase I, Advisor	I-IV 1981-86
Mr Wayne Zabel, Army Procurement Research Office	Investigator Phase I, Advisor	I-IV, 1981-86
Col Ronald Deep, Air Force Business Research Management Center	Contracting Officer's Representative *(now retired)* for Phase II	II, 1982-84
Mr Bill Muir, Price Waterhouse	Subcontractor Phases III-V, Advisor	III-V, 1984-88
Ms Betty Thayer, Price Waterhouse	Advisor	III-V, 1984-88
Mr Ray Thornton, LTV	Advisor	III-IV 1984-86
Mr Drew Casani, LTV	Advisor	V, 1988
Mr Shabir Shad, LTV	Advisor	V, 1988
Ms Patricia Martin, LTV	Graphics Design and Printing	V 1988
Dr Marvin Agee, Virginia Tech	Faculty Research Associate	III-IV 1985-86
Dr Patrick Koelling, Virginia Tech	Faculty Research Associate	IV-V, 1985-87
Mr Paul Rossler, Virginia Tech	Project Manager	III-V, 1985-88
Ms Sandra DeVries, previously of Oklahoma State University	Graduate Research Assistant	II 1982-84
Mr Jeff Swaim previously of Oklahoma State University	Graduate Research Assistant	II 1982-84
Mr Chell Roberts, Virginia Tech	Graduate Research Assistant	III-IV 1985-87
Mr Eric Pappas, English Department, Virginia Tech	Technical Editor	V, 1988



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Challenges

Visions

Planning

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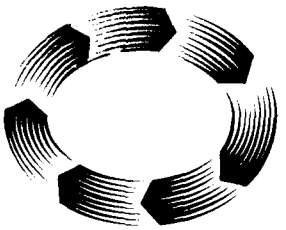
Excellence



Chapter 1
What the Aerospace and Defense Contractor of the Present Faces

Key Points:

1. The U.S. and the A&D contractor community face a challenge in the form of a New Competition. (p. 2)

2. The New Competition is performing at levels that are orders of magnitude greater than traditional and current levels of performance in the U.S. (p. 3)

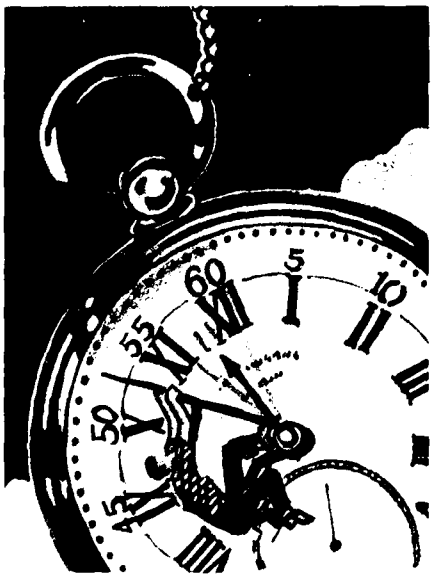
3. There will be roadblocks preventing you from responding to the challenges you must overcome. (p. 6)

4. History has taught us lessons that leaders in the A&D community must acknowledge and overcome. (p. 8)

5. The response to the challenge of the New Competition involves a dramatic change in processes and practices. (p. 11)

Challenges

The A&D Contractor of the Present Faces Significant Challenges



Aerospace and Defense contractors face increasing levels of new competition and the difficult task of learning to compete with the new competition at a point when our economic condition, according to Lester Thurow, Dean of the Business School at MIT and respected economist, is at its weakest since World War II. Jack Grayson, Chairman of the American Productivity and Quality Center, suggests that our nation has less than two decades to improve quality and productivity in order to maintain the economic strength we've enjoyed during the past century. Aerospace and Defense contractors may have even less time to improve quality and productivity. The rapid rate of technological innovation, a dynamic and turbulent environment, increasing global competition, and stiff pressures from a beleaguered federal government are major factors that are shaping the challenges. You have seen the statistics; we won't repeat them here. You are living in and managing extremely complex and technical organizations. We don't have to validate the challenge for most of you. We must develop improved responses to these challenges if the A&D community as we know it is to survive.

Challenges

The New Competition Is Performing at Impressive Levels

Knowing who your competition is and how good they are is just good business sense. Numerous organizations are formalizing this process and calling it "competitive benchmarking."

"The toughest part about competitive benchmarking is communicating to your people just how tough the competition is."

(Paul Regensburger, Xerox)

We have studied performance levels of the typical U.S. firm as contrasted with the "New Competition." The table below presents a summary of our findings. Our point is that your new competition is performing better than you are, in some cases, orders of magnitude better.

Standards of survival in the '80s, '90s, and beyond are changing.

KEY PERFORMANCE INDICATORS	TYPICAL U.S. LEVELS OF PERFORMANCE	COMPETITION'S LEVEL OF PERFORMANCE
QUALITY	Parts per hundred	Parts per thousand, ten thousand
	Don't fix what isn't broken	Constant improvement
	Reliance on inspection	Total quality management
EMPLOYEE INVOLVEMENT	Individual suggestion systems	Team "Proposal" systems
	Employee involvement means **anybody** but management	*Employee involvement means* **everybody** in the organization
	Win-lose/zero-sum games for sharing information, knowledge, power and rewards	*Win-win/nonzero-sum games for sharing* information, knowledge, power and rewards
	One implemented improvement/employee/ year	10, 20, 30, 40 or more implemented improvements/employee/year
COSTS	Recovered through customer price *increases*	Profitability through internal performance
SCHEDULE	Financially driven	Quality and customer driven
PRODUCTIVITY	Through cost reduction and layoffs	Through increased quality, effectiveness, efficiency, quality of work life, innovation, customer orientation
INVENTORY SYSTEM	Push "Just in case"	Pull "Just in time"
TECHNOLOGY AND INNOVATION	Dedicated, complex, and sophisticated	Appropriate and flexible, appropriately complex
	High-tech/low-touch	High-tech/high touch
	"Technology will solve the problem mentality	*Employees indicate where technology is* needed most
BOTTOM LINE	Emphasis on operational plan, technical requirements of product	Emphasis on strategic plan
	Short-term profits, maintenance of the "status quo"	Long-term growth, survival, competitiveness, constant improvement

Challenges

*The Impact On Your World As a Manager in Defense – "A World Turned Upside Down"**

The levels of performance we spoke of on the previous page are being achieved through revolutionized ways of doing business. Management principles, processes and practices are being modified to meet new internal and external environments, new technologies, a global economy, and the changing demands of employees and customers. Tom Peters speaks to this in his article, "A World Turned Upside Down."

The changes required to compete in a global economy are dramatic.

	THE OLD WAY	THE NEW WAY
MANUFACTURING	Capital and automation more important than people. Volume, low cost and efficiency more important than quality and responsiveness.	Focused factory, short runs, flexibility. People as important/more important than capital – quality and responsiveness are principal goals.
INNOVATION	Central R&D as driver, big projects as norm. Cleverness of design more important than reliability, serviceability. Innovation limited to new products and services.	All activities are hotbeds for innovation. Product development cycles cut by 90% or more. Innovation with key customers/ suppliers; early involvement of customers.
PEOPLE	Capital more important than people. Excessive training is wasteful. People need tight controls. Money is the only motivator.	Quality, service and responsiveness through people more than through capital. Everyone part of a self-managing team. Extensive training. Gainsharing/employee stock ownership.
ORGANIZATION	Hierarchial, staff centered. Officially matrixed to solve coordination needs.	Flat, line dominated. Business team, task team, small group focus.
MANAGEMENT INFORMATION SYSTEM	Centralized information control. Data and information hoarders. DRIP – data rich and information poor.	Decentralized. Central MIS as staff advisors for the strategic use of information. Management support systems.
FINANCIAL MANAGEMENT AND CONTROL	Centralized. Staff as reviewer of all proposals, formulator of extensive guidance. Staff as cop.	Decentralized. Most finance people in the field. High spending authority at facility/ business unit level.
LEADERSHIP	Detached, analytic. Centralized strategic planning. Dominated by central corporate and group executive staffs.	Decentralized. Value driven, strategic development from below. Top management staff in touch with customers and operations. Leader as visionary.

*FROM *THE ACADEMY OF MANAGEMENT EXECUTIVE*, VOL. 2, NO. 1, PP. 223-234.

Challenges

The Challenge is a Highly Competitive Race without a Finish Line...and the Pace and Stakes are Rapidly Increasing

The challenge that A&D managers must confront is how to become increasingly competitive in the face of limited time and resources.

The production environment of A&D contractors is increasingly complex, but this is a race to be won or not run at all. It may be the greatest industrial challenge in U.S. history. We need to organize and manage to face the stiffest competition we have ever encountered.

Managing quality and productivity may look easy on paper, but you know how difficult it is in reality. The complex environment in which you manage makes implementing the simplest concept or technique a challenge, even for the most experienced and politically astute change master.

Challenges

The Complex Competitive Environment of a Defense Contractor

Roadblocks and Operating Constraints

Managing the transition from your organization of the present to your organization of the future is not easy. A document like this one can only help to crystallize the tasks ahead of you and provide a roadmap for change for your management team. Even with a clear roadmap, there will be roadblocks and operating constraints that will "conspire" to prevent you from succeeding. Our Government Industrial Advisory Board (see Appendix D) identified the following roadblocks and operating constraints at our Evaluation Workshop:

- Business awarded to low bidder
- Program instability
- Short-term contracting
- Competition advocacy
- Cost-based pricing and profits
- Micromanagement
- "Audit to punish" mentality
- Lack of risk sharing
- Public perception
- Inadequate cost management systems
- Insufficient improvement incentives
- Program manager emphasis
- Inconsistency between and within the services, DoD, and Congress
- Lack of front-end planning and investment
- Non-integrated approach to problem solving
- Technical performance valued to the exclusion of productivity, quality, and cost
- Negotiation of rates and factors independent of total product cost
- "How to" requirements
- Specifications, standards, warranties
- Anti-trust laws
- Redundancy of activities
- Reliance on inspection after the fact
- Technical data rights
- Fixed-price development contracts
- Focus on insufficient issues, misuse of resources

The Contrasting Wants of Contractors and the Government

In addition to roadblocks like the ones listed above, your organization has different and sometimes conflicting objectives than the government. These differences create additional complications to the process of quality and productivity management.

CONTRACTOR WANTS:

- **Survival**
- **Profits based on performance, not costs**
- **Growth and market share**
- **Less risk and uncertainty**
- **More autonomy**
- **Less regulation**

GOVERNMENT WANTS:

- **Readiness, sustainability, survivability**
- **Credible military capability**
- **Economic and political power**
- **Ability to deter aggression**
- **Lower acquisition costs**
- **Controls and accountability**
- **Improved industrial base**
- **Higher quality**

Challenges

Trends Facing the A&D Industry

1) World tensions continue to be the most persuasive argument for a strong defense; we live in a time of "violent peace."

2) The reduced percentage of GNP for defense spending will mean a zero or slightly negative growth. This will lead to program stretch-outs, product improvements rather than new starts, and increased competition rather than sole source. The impact will result in limited opportunities and higher investment thresholds for participation in future programs.

3) International competition in defense products and services has become more intense as more nations provide assistance to aid domestic defense producers.

4) Budget pressures in the U.S., resulting from budget deficits, have caused the political spotlight to be increasingly focused on national defense costs and various factors – including productivity – that affect these costs.

5) Domestic firms are competing more intensively than ever for a share of the Department of Defense purchases as the defense budget is squeezed by deficit pressures.

6) Changes in defense procurement practices have increased the use of co-production agreements with foreign firms.

7) Tactical weapons systems have increased as strategic systems have decreased.

8) The industry faces increased standardization of parts.

These trends complicate your challenge and the tasks ahead.

Challenges

Lessons from history:

The U.S. defense industry has been and still is a leader

There are observable and repeated trends in the process by which a world leader slowly but surely loses its leadership in productivity, economic vitality, and eventually, economic power and influence. Historian Arnold Toynbee viewed maintaining excellence as a series of "challenges and responses." He concluded, after an exhaustive study of civilizations, that the rise and fall of nations are matters of choice and are not repeated patterns.

Grayson and O'Dell (1988) list ten lessons from history, factors that have caused leaders to decline and challengers to rise and take their place. We suggest that these lessons are as equally valid for A&D organizations and your industry as they are for our nation.

Lessons from History: Leaders' Perceptions

Lesson 1 – **Complacency is the cancer of leadership.**

Five factors tend to contribute to a growing sense of complacency:

1 – Affluence

2 – Lack of Competition

3 – Belief in Invincibility and Immortality

4 – New Challenges are met with Old Responses

5 – Disregarding the Challenge.

Lesson 2 – **Leaders overlook the relative growth rates of their challengers.**

Assuming that the 1973-1986 productivity growth rate trends continue, by the year 2003, the U.S. will rank seventh in absolute productivity as measured by Gross Domestic Product per employee. Canada (1994), France (1996), Norway (1998), Germany (1999), Belgium (2000), and Japan (2003) will all, in the years indicated, overtake the U.S. A small competitive advantage by a firm with a continuous improvement culture magnifies quickly over time.

Lesson 3 – **Changes are so slow that leaders fail to sense challenges.**

Competitors often creep up on you at relatively slow rates, such that leaders fail to detect and respond to the challenges.

Lesson 4 – **Initial size is not a predictor of winners.**

A leader tends to overlook small challengers as insignificant at first. When they grow larger, the leader tends to think the challenger must be engaged in "unfair" competition – "if we are losing, it must be an unfair fight."

Lessons from history: the ways of the challenger

Lesson 5 – **Gainers have drive.**

Challengers have "the eye of the tiger." Leaders lose the drive they had to become leaders.

Lesson 6 – **Challengers stress education.**

Emphasis on education, and how it is focused and implemented, is stronger in challengers than in leaders.

Lesson 7 – **Gainers copy leaders.**

We somehow have the impression that we didn't copy leaders in our rise to number one. We did. Followers don't simply copy the leader's ideas; they adapt them, improve them, and (most importantly) put them to work quickly.

Lessons from history: the challenger closes in

Lesson 8 – **Challengers stress quality improvement and customer focus.**

Leaders become arrogant and begin to neglect those things which made them successful. Challengers attack these deficiencies in the performance of the leaders and use them to win.

Lesson 9 – **The paradox of protection – it helps challengers; it hurts leaders.**

Challengers use protection to help get started and catch up. Leaders tend to use protection not for growth, but to reduce competition, to "save" jobs in inefficient industries, and to prevent change.

Lesson 10 – **The leader's ability to adjust diminishes over time.**

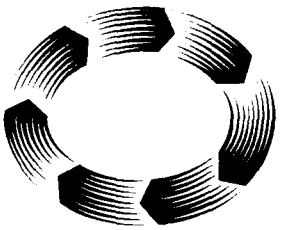
The longer a leader is a leader, the more difficult it becomes to adapt.

Challenges

Summary

We believe that most, if not all A&D contractors are painfully aware of the challenges they will face in the next decades. Both the DoD and the defense industry have been actively involved in efforts to meet the challenges, and there is a growing consensus among managers and practitioners that A&D contractors will need to do business differently in the future if they are to survive. Is this awareness pervasive in your organization? Have you shared enough information to ensure that everyone understands the magnitude of the challenge? Are you sure there isn't a "maintaining the status quo will be sufficient for survival and success" attitude in your organization? Awareness of the challenges is the first step to improving performance. But as Paul Regensburger of Xerox says, it is difficult to effectively communicate just how tough the new competition is.

Our next element of the Performance Management Process is the development of visions for the contractor of the future.



Chapter 2
What the Aerospace and Defense Contractor of the Future Must Look Like

Key Points:

1. Performance management, quality, and productivity improvement require a vision of the "organization of the future." (p. 14.18)

2. There is a systematic "grand strategy" that conceptually represents the evolution from the "defense contractor of the present" to the "defense contractor of the future." (p. 16)

3. Motives and incentives need to be established for people in your organization to be active about performance improvement. (p. 15)

4. Underlying values and beliefs, stated in the form of guiding principles, need re-examining and realignment. (p. 17)

5. Management processes and practices need to be redesigned and more effectively implemented in order for you to successfully respond to the challenges you face. (p. 20)

Vision Establishes a Competitive Direction

The term "A&D Contractor of the Future" represents a vision of what your organization must become in order to compete and survive in the future. We appreciate the fact that this is a vague term that, at least at this point, lacks an operational clarity. This problem will be alleviated in a later chapter.

Bennis and Nanus, in their book, *Leaders: The Strategies for Taking Charge*, stress the importance of establishing and communicating a vision of a future state, a condition that does not presently exist and has never existed before. With a vision, the leader provides an organization with an all-important bridge from the present to the future. The authors found that effective leaders paid attention to the challenges posed by the New Competition, determined what part of the events at hand would be important for the future of the organization, set a new direction (a vision), and concentrated organizational attention on this vision.

A vision cannot be established in an organization by edict or coercion. It is more an act of persuasion, of creating an enthusiastic and dedicated commitment to a vision, because it is right for the times, right for the organization, and right for the people working toward it.

Motives and Incentives for You or Your Organization to Respond to the Challenge

Having discussed the multiple challenges facing your organization, we are now talking about responses. Here is an important question for you to consider as a manager in an A&D company:

> Why should anybody in your organization do anything to respond to the challenge?

REASONS TO BE ACTIVE	REASONS TO BE PASSIVE
Take initiative in the absence of leadership, vision, consistency and purpose to develop plans, strategies	Initiative limited to job description and normal work duties; culture supports "just get the job done" attitude
Ignore the measurement and reward system; politically astute, but takes risks	Measurement and reward systems measure and reward "A" (maintaining the status quo) while hoping for "B" (constant improvement)
Think and plan long term, despite constant short-term pressures and demands	Prefer to react to situations and "fight fires," succumb to short-term pressures
Welcome change and enjoy taking risks	Comfortable with the status quo and resist change
Change institutionally mandated; top management support and involvement	Wait this program out just like the last one and the one before it

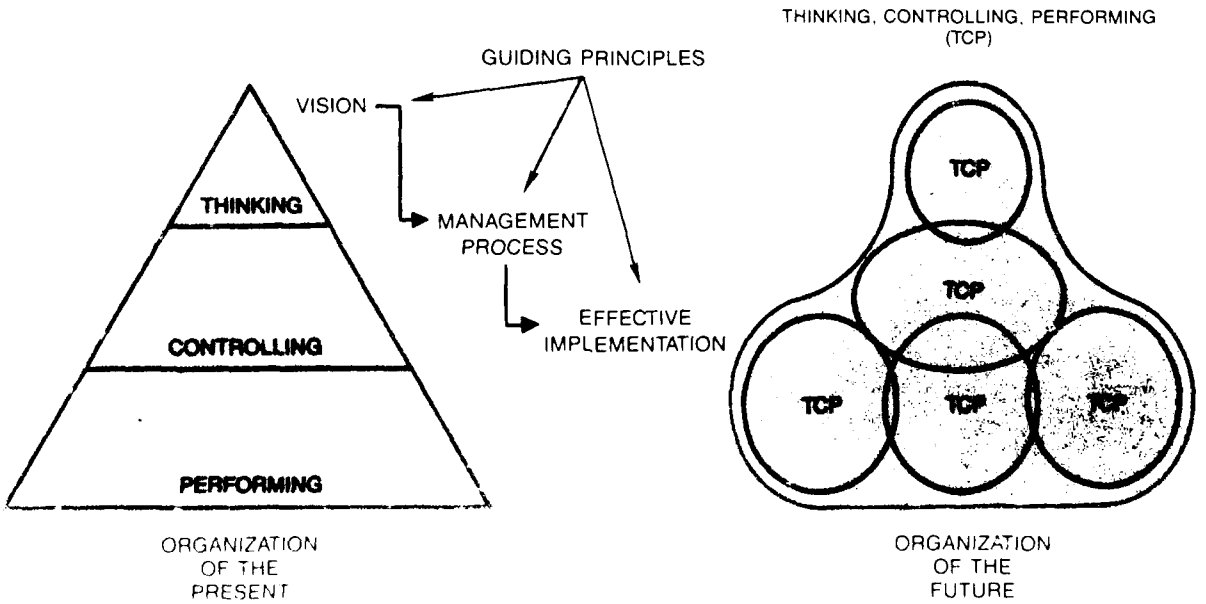
If you are critically introspective you will find there are more motives and incentives for your people to do nothing, or be very passive or reactive, than for them to be active, proactive, aggressive. The table to the left identifies reasons why people in your organization might be passive or reactive, and reasons why they might be proactive.

Most U.S. organizations have unintentionally and unwittingly created a passive, reactive, "don't fix what isn't broken" culture. How long has it taken for the "maintain the status quo" culture to evolve in your organization? 10 years? 20 years? 50 years? The point is that you cannot undo overnight what has been created over a period of years. An early task in responding to these challenges is to begin to improve the management of your culture. You must create a culture, complete with measurement and reward systems, that will create greater proactivity.

Evolution of the A&D Contractor of the Present to the A&D Contractor of the Future

In most U.S. organizations, people at the top think; people in the middle control; and people at the bottom perform. This is a generalization and an overstatement. However, we do not share as much information, knowledge, power, and rewards as we should. We have not moved the responsibility and accountability to the lowest appropriate level in the organization. We find that people who tend to disagree with these statements most vehemently are those in positions of power. In our vision of the A&D Contractor of the Future, thinking, controlling, and performing occur at all levels.

What are the strategic factors managers in A&D must focus on to become the Contractor of the Future? If strategic factors are effectively managed, you will succeed; if left unattended or mismanaged, you will fail. Research, literature, and our experience suggest that vision, guiding principles, management processes, and effective implementation are the strategic factors to which managers in defense must pay attention.



Visions

Guiding Principles

Culture, values, beliefs, and guiding principles are words we didn't hear five years ago. Then, as quality and productivity programs began to experience difficulties, we heard managers talk about the importance of these terms.

Guiding principles operationalize an organization's values and beliefs, and guide, shape and direct behavior. They are the building blocks of corporate culture.

Crystallizing Your Vision of the Future

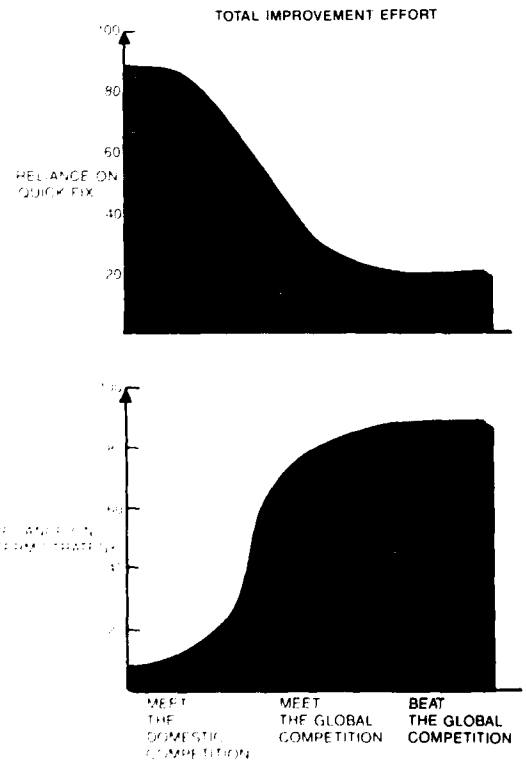
We invite you to contemplate characteristics of selected management processes in your organization as they exist today, and contrast those with the characteristics of your organization of the future. Feel free to write in the spaces provided on the next page. The result will provide you with an explicit statement of the gap you must close. For example, how does your organization do planning today? How must it do planning in the future?

We would like you to think about your organization as it looks, behaves, and performs today and how it will be necessary to look, behave, and perform in the future. Respond to any or all of the strategic factors for which you believe there will be a need for substantial change. Have key decision-makers in your organization complete this table, and then discuss the results. This is a critical step to becoming a better organization.

Visions

DIMENSIONS	ORGANIZATION OF THE PRESENT	ORGANIZATION OF THE FUTURE
GUIDING PRINCIPLES		
PLANNING		
MEASUREMENT		
QUALITY MANAGEMENT		
PARTICIPATION		
REWARD SYSTEMS GOVERNMENT-TO-CONTRACTOR		
REWARD SYSTEMS CONTRACTOR-TO-EMPLOYEE		
CULTURE MANAGEMENT		

Management Processes



Another element in the "Grand Strategy" we are developing is management process. Just like building a weapons system is composed of a complex sequence of design, development, production, and maintenance processes, management is also composed of processes. We often are less systematic and disciplined in defining and executing management processes like measurement and planning than we are production processes. However, as our knowledge of management improves, we are seeing more "engineering of management systems and processes." The table below characterizes and contrasts management present to future outcome.

Critical Challenges and Issues Facing Management

PRESENT	FUTURE
Management is reactive, "fights fires"	Managers are more proactive
The focus is on "quick fixes"	Needs to move beyond the "quick fix"
Step-function, top-down driven improvement	Continuous improvement pervasive at all levels
Little or no effective strategic planning	Pervasive and high-quality performance improvement planning at all levels
Programs with life cycles	Institute processes that change how we do business
React to competitive pressures and governmental initiatives	Anticipate and stay ahead of competitive pressures and governmental initiatives
Maintain the status quo	Constant and continuous improvement
Non-supportive culture, measurement, and reward systems	Supportive culture, measurement, and reward systems

To respond successfully to the challenges posed by the New Competition, technology, government, and the environment, your organization will have to look, behave, and perform differently in these key management process areas:

- Planning
- Measurement
- Quality Management
- Participation
- Management Support Systems
- Structure
- Reward Systems
  - Government to Contractor
  - Contractor to Employee
- Culture Management
- Product and Process Design
- Modernization.

The remaining chapters of this guide are dedicated to a number of the key management processes, which are the "drivers" of change.

Effective Implementation

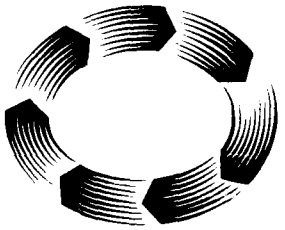
The final element in our grand strategy is effective implementation. Peter Drucker is quoted as having said that "what Americans need to learn from the Japanese is not what to do but to do it."

Attempting to achieve and maintain effective implementation confuses most organizations. A commitment to become the Contractor of the Future is not enough; we must be willing to pay the price. Continuous support and involvement from management and a visible tracking system will help ensure that your organization becomes a Contractor of the Future.

Summary

How can you make your vision a reality? At the beginning of this chapter, management processes were depicted as the link between your vision and effective implementation. One of the management processes identified was planning. An effective, high-quality planning process can help you successfully respond to the challenge and move toward your vision.

The next section focuses on a detailed description of a tried and tested planning process. It has been designed and engineered to overcome many of the problems with planning that U.S. organizations have encountered in the past twenty to thirty years. It is a specific process, with embedded techniques that your organization can employ to begin to plan for and improve quality and productivity. This process is being used by Honeywell Aerospace and Defense, among many others.



Chapter 3
How to Create Plans for Quality and Productivity Improvement

Key Points:

1. Developing a high quality improvement plan that is accepted and effectively implemented is an important and challenging task. (p. 26)

2. Improvement Planning is part of everyone's job, from the president on down. (p. 26)

3. If the process by which plans are developed is a quality one, then the resulting plans should also be of high quality. (p. 26)

4. We present an effective, pragmatic, and highly participative eight-step process you can use to improve the quality, acceptance, and implementation of improvement plans. (p. 28)

5. The process requires a long-term commitment of time and resources in order for it to become a part of the way you do business. (p. 37)

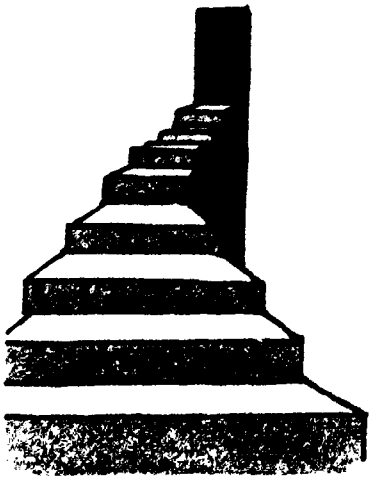
Improving Planning Quality

Developing an overall strategy for improving quality and productivity that will be accepted and effectively implemented is an important and challenging task.

If the process by which plans are developed is good, then the resulting plans should also be good. We appreciate the fact that the process depicted on page 29 looks rather sterile on paper. The process has, however, been implemented successfully in a number of private and public sector organizations. We encourage you to experiment with it in your organization. Proper execution of this process will result in a well-thought-through and well-supported plan. The process is highly participative and ensures that the plan itself will be responsive to the various needs of the organization; it is designed to be completed in a two-to-three day retreat-type planning session. We include examples for each step in Appendix A.

TYPICAL PLANNING IN U.S. ORGANIZATIONS	CHARACTERISTICS OF AN EFFECTIVE PLANNING PROCESS
• Formal, with a focus on the plan	• Less formal, with a focus on both plan and process
• Budget drives the plan	• Plan drives the budget
• Involves only top management	• Participation at all levels
• Finance and operations imbalanced	• Balance between finance and operations
• Myopic and short-sighted	• Broader and longer term
• Little or no effective implementation	• Plans expeditiously and consistently implemented
• Little or no necessary management and resource support	• Necessary management and resource support
• Little or no reporting on progress	• Follow-up and feedback
• Isolated activity	• Activities integrated with other planning functions and systems
• Limited discussion and analysis of plans	• More pervasive discussion and analysis of plans
• Process complex and lengthy	• Process simple and effective
• Planning tends to be static and not in touch with operational realities	• Dynamic, flexible and pragmatic
• Believes effective implementation is only a function of the quality of the plan	• Recognizes effective implementation is a function of the quality and acceptance of the plan

Step 1: Organizational Systems Analysis



The first step in the planning process is designed to prepare the management team to plan. Organizational Systems Analysis (OSA) involves eight basic areas of analysis and is designed to be accomplished in a structured, participative fashion by a management team. The eight areas of analysis are:

1) Vision (Corporate Long-Range Objectives)

2) Guiding Principles (Values and Beliefs)

3) Mission (Purpose)

4) Input/Output Analysis (see Measurement Chapter for a description of IOA)

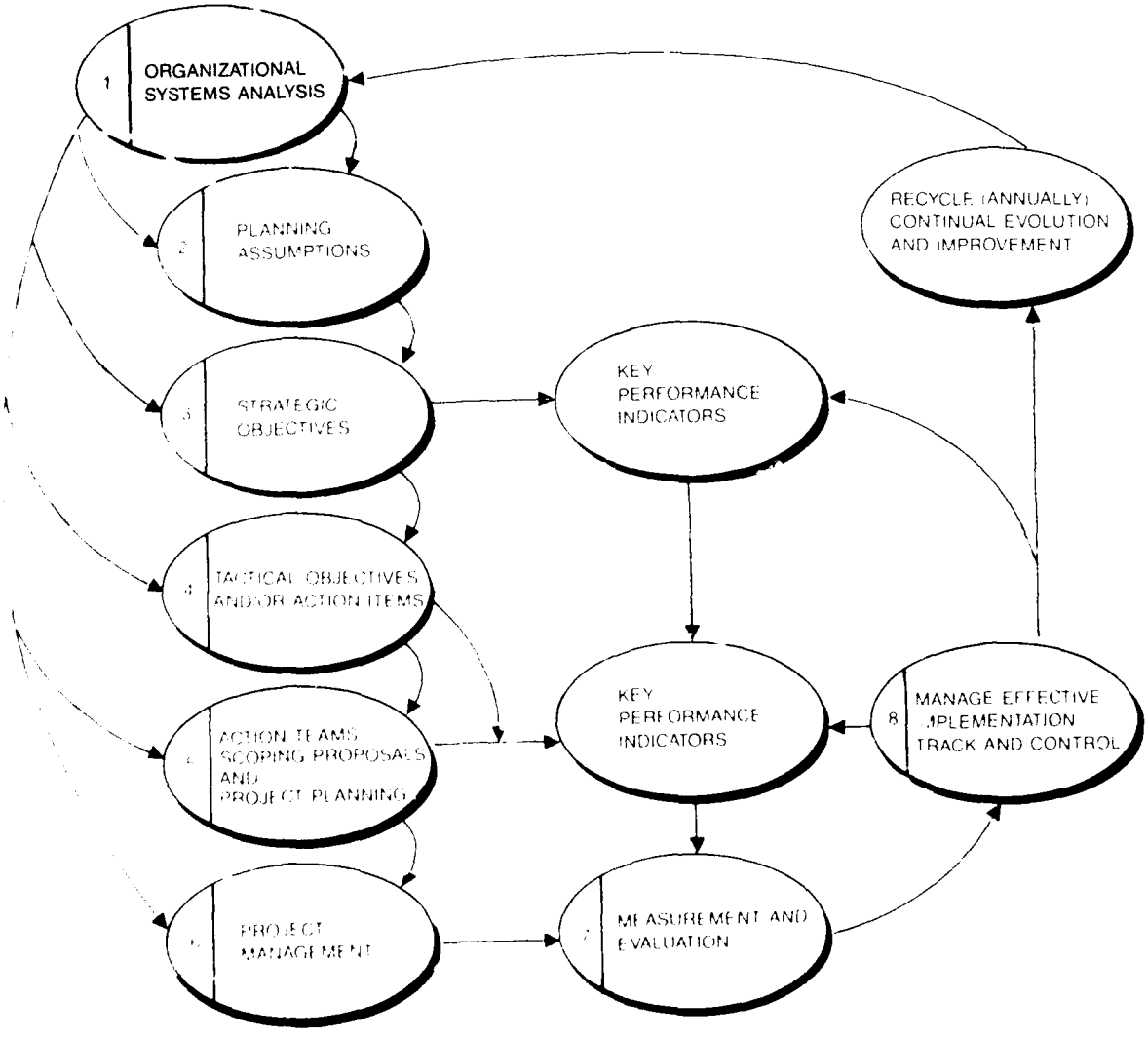
5) Internal Strategic Analysis

6) External Strategic Analysis

7) Current Performance Levels

8) Roadblocks to Performance Improvement

Answers to the inevitable questions raised by OSA may already exist, but they may not have been well-communicated or may need to be reviewed and clarified. Procedures can be developed to assist with the process of data collection.


1 ORGANIZATIONAL SYSTEMS ANALYSIS
2 PLANNING ASSUMPTIONS
3 STRATEGIC OBJECTIVES
4 TACTICAL OBJECTIVES AND/OR ACTION ITEMS
5 ACTION TEAMS SCOPING PROPOSALS AND PROJECT PLANNING
6 PROJECT MANAGEMENT
KEY PERFORMANCE INDICATORS
KEY PERFORMANCE INDICATORS
7 MEASUREMENT AND EVALUATION
8 MANAGE EFFECTIVE IMPLEMENTATION TRACK AND CONTROL
RECYCLE (ANNUALLY) CONTINUAL EVOLUTION AND IMPROVEMENT

Step 2: Planning Assumptions

Step 2 converts the data shared in Step 1 into specific planning assumptions. Assumptions can have a dramatic influence on what must be considered while developing the plan and must be clearly understood by everyone. The desired outcome of Step 2 is an awareness and group consensus as to the importance and validity of the various planning assumptions. The process for accomplishing this is:

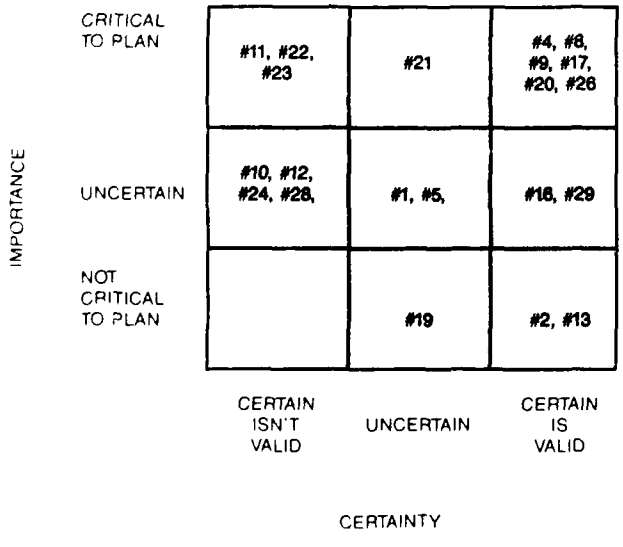
1) The planning team members each silently generate a list of assumptions.

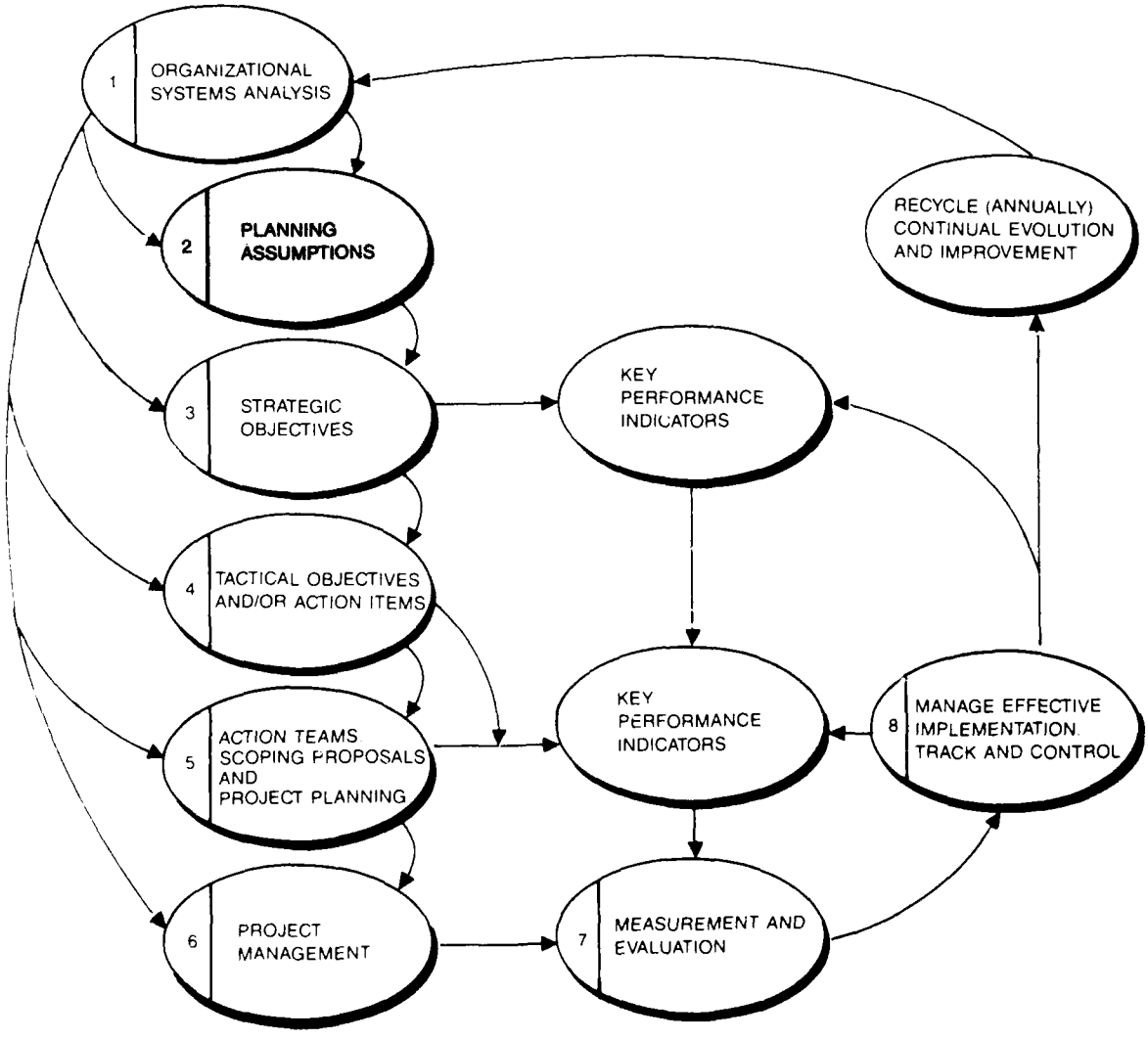
2) A round-robin process is used to solicit and list the assumptions. The assumptions are written on flip-chart paper and taped to the room walls. Each assumption is numbered sequentially in the order in which it is listed on the flip-chart paper. Lists of 30-60 assumptions are not uncommon.

3) Each team member is then given an importance-validity grid. The number of each assumption is then put in the square that best describes how critical and certain it is.

4) All the grids are collected, and one grid for each assumption is then created.

5) Analysis and discussion of the assumptions follow.





(SOURCE: SINK AND TUTTLE, 1989)

Step 3: Strategic Objectives and Step 4: Action Items

The question being addressed in Step 3 is: What must we, as an organization, accomplish in the next 'x' years (typical planning horizon is 5-7 years)?

A proven efficient and effective technique for executing Step 3 is the Nominal Group Technique (the NGT is described in detail in Chapter 4). The NGT process increases commitment to the final plan, improves communication and coordination, and leads to effective implementation. The resulting set of objectives is audited against the output from Steps 1 and 2 to assure consistency. Step 3 takes about two-and-a-half hours for the initial cut. The output from the NGT session will have to be revised and clarified to present upline or to different audiences within your organization.

The issue of measurement often arises at this point. Key Performance Indicators (KPIs) should be developed for each objective. KPIs address the following questions:

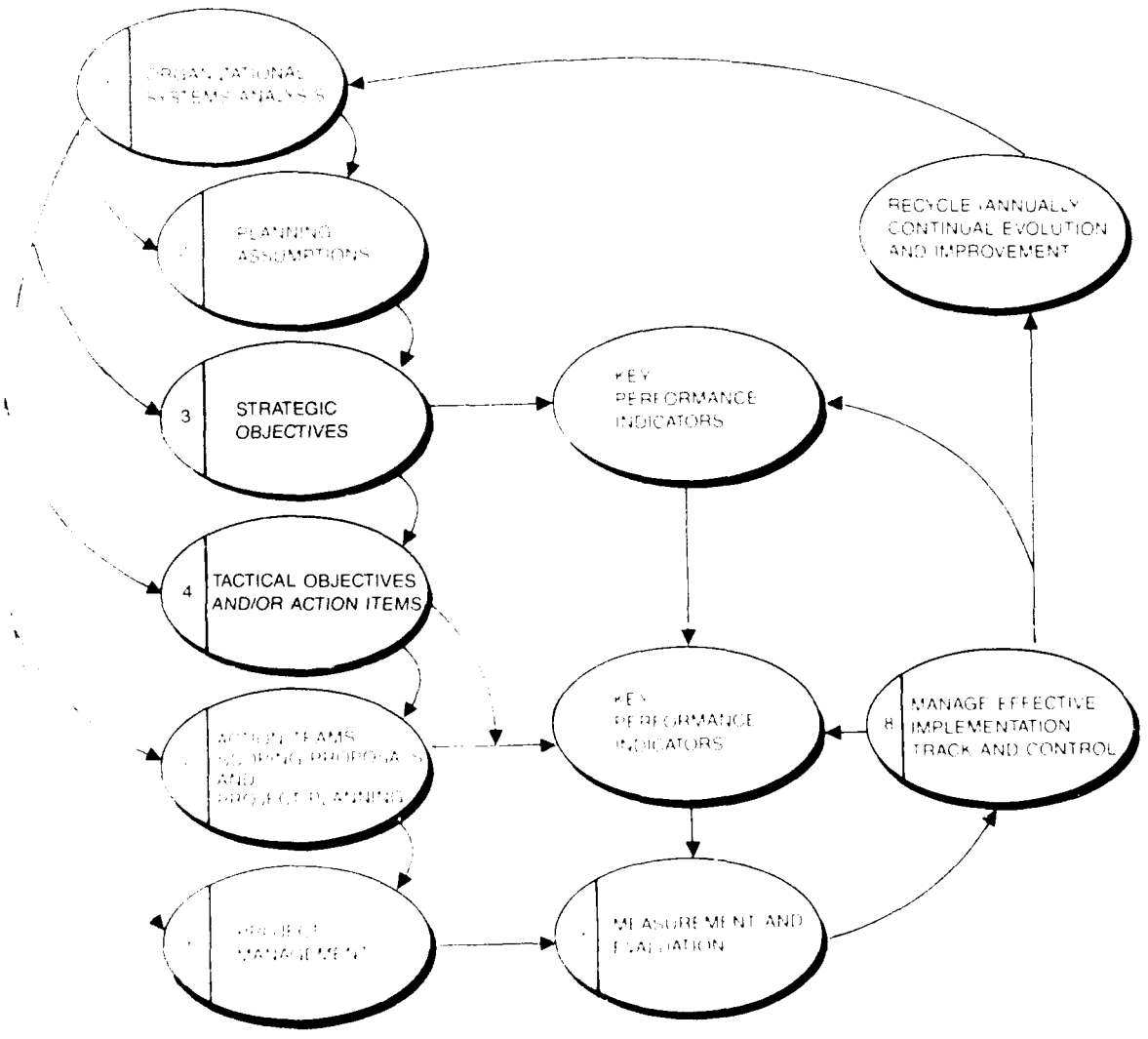
1) Have we met our objective? (an effectiveness issue)

2) Were resources consumed wisely? (an efficiency issue)

3) Have we met our quality standards?

4) What will be the impact on performance?

Using your previously generated strategic objectives as a guide, a series of action items needs to be developed. Step 4 is identical to Step 3 with respect to how it is accomplished. Two things change. First, Step 4 deals with start, not finish, issues. Second, the planning period shifts from 5-7 years to 0-3 years.


RECYCLE ANNUALLY
CONTINUAL EVOLUTION
AND IMPROVEMENT
PLANNING
ASSUMPTIONS
3
STRATEGIC
OBJECTIVES
KEY
PERFORMANCE
INDICATORS
4
TACTICAL OBJECTIVES
AND/OR ACTION ITEMS
KEY
PERFORMANCE
INDICATORS
8
MANAGE EFFECTIVE
IMPLEMENTATION
TRACK AND CONTROL
MEASUREMENT AND

Step 5: Action Teams

Step 5 is the link between planning and effective implementation. Volunteer teams of 3-5 people are identified to develop scoping proposals. These teams are the managers involved in Steps 1-4 and may be supplemented by staff and lower level managers and employees. These teams are given approximately one month to develop a scoping proposal for their respective action items. A scoping proposal addresses such things as:

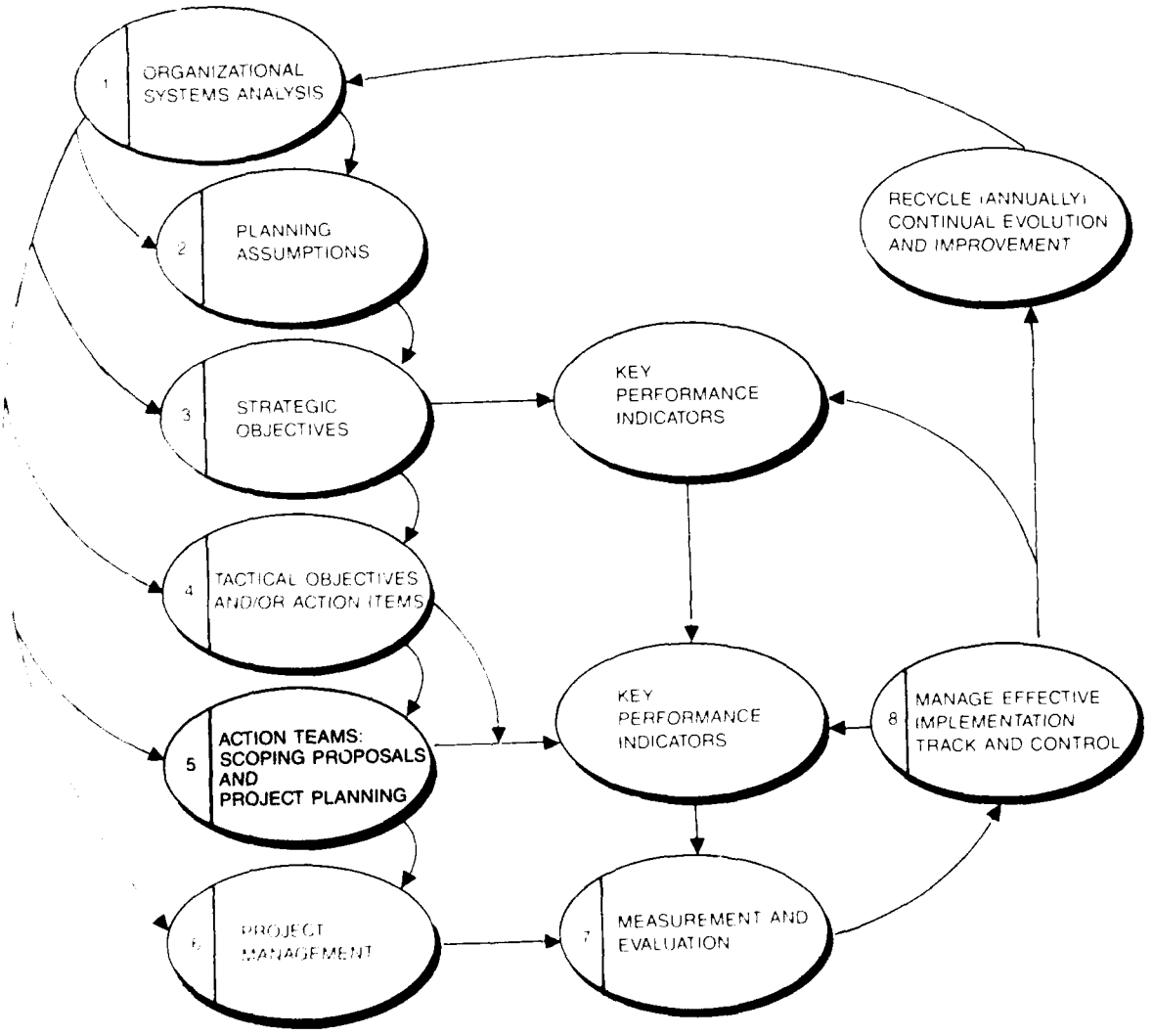
- What has to be done?
- Who has to be involved?
- When should activities occur?
- How should the project be implemented?
- What are the associated costs and benefits?
- What are the measures of success?

A completed scoping proposal should be fewer than five pages in length and should "scope out" implementation planning. Many organizations incorporate a review and evaluation process in this step. Scoping proposals are reviewed by a quality and productivity council or committee composed of members of the planning team. Once a "green light" is given to each scoping proposal, an implementation team is formed.

The elapsed time from Step 1 to the completion of Step 5 should be no longer than three months and should precede the budget planning process by 3-4 months so that the plan drives the budget, not the reverse.

Traps to Avoid

"Make sure no one is on more than one [illegible] team. The planning process has a tendency to get people "fired up" and causes teams to volunteer for more than they are able [illegible] people to action items no one [illegible] to tackle. Remember, not [illegible] to be done today!"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RECYCLE (ANNUALLY) CONTINUAL EVOLUTION AND IMPROVEMENT

Final Steps: Project Management, Measurement and Evaluation, Effective Implementation, Evolution

Step 6: Project Management

Project management is both a science and an art. However, the art, the skill, and the discipline associated with this step of performance improvement planning are far more important than any specific project management technique. Effective project management, as experienced managers know, requires attention to detail, persistence, impatience, patience, consistency, discipline, communication and coordination, as well as the application of appropriate techniques.

Step 7: Measurement and Evaluation

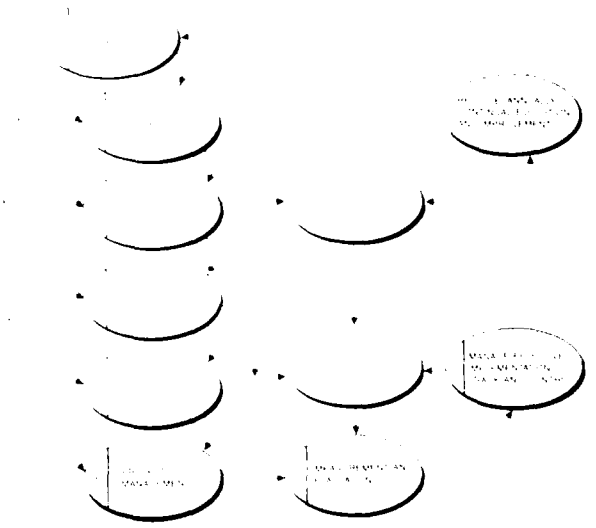
Step 7 of the planning process involves measuring, assessing, and evaluating the impact of strategic and tactical objectives on organizational system performance (Measurement is addressed in Chapter 5). Planning team members are held accountable for tracking implementation progress and for measuring impacts using new or existing measures or measurement systems. Many organizations develop a visibility room for displaying these measures. This step continues for the duration of the year and provides data for repeating the process next year.

Step 8: Managing Effective Implementation

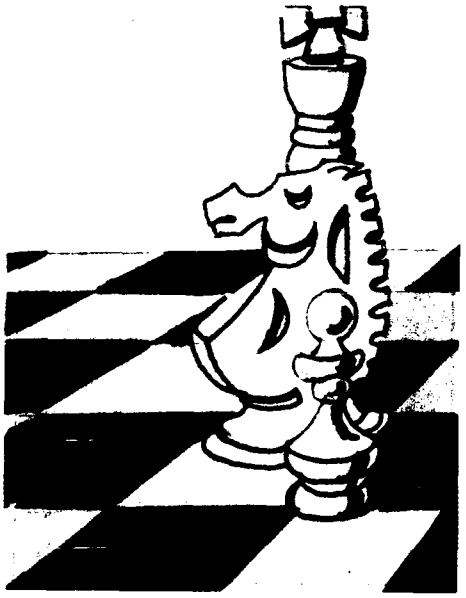
Continuous support from management and a visible tracking system will help ensure effective implementation. Having quarterly review meetings will help track progress: a half-day session for the first and third quarter reviews; a full-day session for the mid-year review; and a two- or three-day fourth quarter session to review progress, update the plan, and identify ways to improve the process.

Recycle (Annually): Continual Evolution and Development

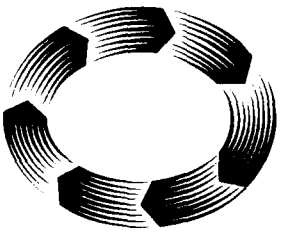
It is essential for any A&D Contractor to tailor and modify this process annually. Involvement and participation in the process will vary from company to company, but the process can still be applied to a division on down to a work group, or even to a programmatic thrust (e.g., a quality and productivity effort).



Summary



This chapter presented a process with which you can develop plans for quality and productivity improvements. The process can be moved down and across the organization, focusing on those steps of the process that make sense for the target system. Implementation organization-wide must be approached carefully. A "Grand Strategy" must be developed that maps out where you're headed with the process and your implementation strategy for moving the process. As your organization gains experience with the process, you will need to modify and tailor it to better fit your evolving improvement effort. The process requires the commitment of time and resources and requires a minimum of three to five years to become a part of the way you do business. For more on how to effectively implement this process in your organization, see Sink and Tuttle (1989).



Chapter 4
Strategies and Techniques to Improve Quality and Productivity

Key Points:

1. Productivity and quality improvement efforts must be well-planned and well-integrated from a corporate perspective. (p. 40)

2. Your organization must develop a "Grand Strategy" for improvement. (p. 40)

3. Progress in five basic improvement strategy areas is critical to your overall success. (p. 41)

4. You must operationally define, measure, and manage quality at five basic checkpoints in order to implement Total Quality Management (TQM). (p. 42)

5. The DoD has a major TQM initiative that is gaining momentum

6. More effective management of participation is essential to making other improvement interventions, such as automation, just-in-time manufacturing, and gainsharing work. (p. 48)

7. The Nominal Group Technique is an excellent mechanism to help you improve your participative management efforts. (p. 55)

8. Finding effective ways to share the benefits of improved performance, within your company and between the government and your company, will be a critical element in your Grand Strategy. (pp. 60, 66)

9. Establish processes for improvement; control their variance, and "shift their mean" (improve the performance of those processes).

Effective Improvement Strategies and Techniques are Well-Integrated

The planning process will generate a number of strategies to improve quality and productivity. These strategies will be based upon the insights and wisdom of the people in your organization. The structured and participative nature of the process we have described ensures commitment and enhances effective implementation. Techniques will often be required to capitalize on the various performance improvement goals and objectives. In other words, we know what to do, but now we need a path (*technique*) by which to accomplish our objectives. Within the strategies are a number of techniques used to improve quality and productivity. Too often improvement techniques are approached like a restaurant smorgasbord -- we pick and choose techniques without a grand strategy to guide our selection; we make our selections with only short-term objectives in mind. Long-term, effective quality and productivity improvement requires using techniques in a *comprehensive and integrated manner.* Integration and effective implementation are the keys to success.

This chapter focuses on strategies that integrate quality and productivity improvement efforts. The table on the following page depicts the major present, emerging, and future strategies and techniques in the defense industry. Improvement efforts must be integrated within a column of the table, across a row of the table, and within a cell of the table. The planning process described in the previous chapter not only helps you identify improvement strategies but also integrates your improvement efforts across a row (e.g., integrating your quality management effort with measurement, reward systems, management of

Improvement

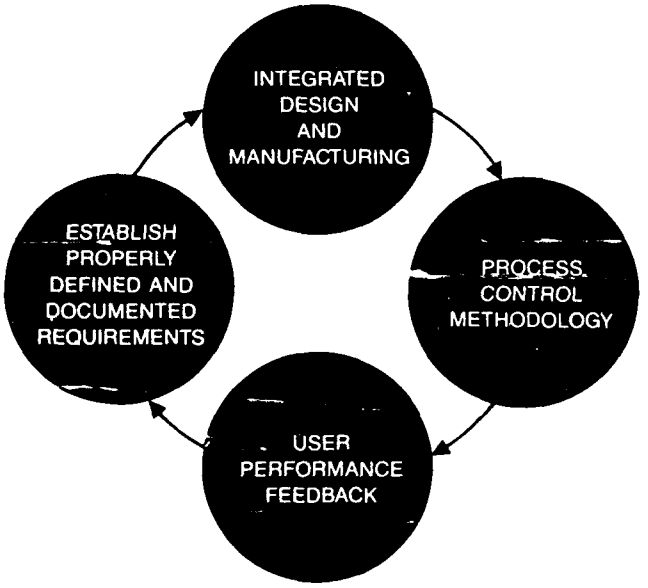
participation), and is a way to improve the extent to which planning is linked to effective implementation and actually causes improvement. In this chapter we focus on specific approaches and techniques that appear to be the common thread through A&D contractor efforts to better manage quality and productivity.

- Total Quality Management
- Management of Participation
- Reward Systems (Gainsharing)

Both the literature and our experiences during the past 15 years suggest that these three types of interventions, in addition to planning and measurement (discussed in the next chapter), are the real drivers of improved quality and productivity. We will focus our efforts on these. The central question is, of course, how to improve the effectiveness, efficiency, and quality of your efforts in the areas of TQM, participation, and reward systems. References are provided at the end of this guide for those interested in further readings in each area. We begin with a look at total quality management.

MAJOR PRESENT, EMERGING, AND FUTURE IMPROVEMENT STRATEGIES AND TECHNIQUES				
PLANNING	MEASUREMENT	TOTAL QUALITY MANAGEMENT	MANAGEMENT OF PARTICIPATION	REWARD SYSTEM

Total Quality Management



(SOURCE: DoD, 1988)

To be competitive in the face of new competition, A&D defense contractors must focus their efforts in order to improve the quality of products, services, and processes. Most companies are crippled by a myopic mindset about quality, that it can be inspected into a product, and that meeting specifications is equivalent to providing a quality product or service. Fortunately, "quality gurus" exist, and they are beginning to create an awareness that quality is much more than we originally thought it was.

The desired outcome of TQM is improved quality of processes, products, and services, and achieving substantial reductions in the cost of ownership throughout the life cycle of weapon systems. Total Quality Management broadens the concept of quality, focusing on quality much earlier in the system acquisition process.

Quality Defined

Differing views of quality are held by marketing, engineering, and manufacturing departments. Despite the potential for conflict, an organization benefits from such multiple perspectives. The Department of Defense's TQM initiative has changed the definition of quality from "conformance to requirements" to "conformance to correctly defined requirements that satisfy user needs." The definition emphasizes the ultimate goal of quality: products and services that meet customer needs and expectations at a cost that represents the best value.

Differing Views on the Definition of Quality (Source: Garvin, 1988, pp. 40-46)

Transcendent. Quality cannot be defined precisely; instead, quality is a simple, unanalyzable property we learn to recognize only through experience.

"Quality is neither mind nor matter, but a third entity independent of the two . . . even though Quality cannot be defined, you know what it is." (Pirsig, 1974, pp. 185, 213)

Product-based. Quality is a precise and measurable variable. Differences in quality reflect differences in the quantity of some ingredient or attribute possessed by the product.

"Differences in quality amount to differences in the quantity of some desired ingredient or attribute." (Abbott, 1955, pp. 126-127)

User-based. User-based definitions start with the premise that quality "lies in the eyes of the beholder." This is an idiosyncratic and highly subjective view of quality.

"Quality is fitness for use." (Juran, 1974)

Manufacturing-based. Manufacturing-based definitions focus on engineering and manufacturing practices, and define quality as conformance to requirements.

"Quality is conformance to requirements." (Crosby, 1974, p. 15)

Value-based. Quality is defined in terms of costs and prices. A quality product is one that provides performance or conformance at an acceptable price or cost.

"Quality means best for certain customer conditions. These conditions are (a) the actual use and (b) the selling price of the product." (Feigenbaum, 1961, p. 1)

Quality Must Be Managed Relative to Five Checkpoints

In order to make our model of TQM come to life, your organization must operationally define, measure, improve, and manage quality at five "checkpoints."

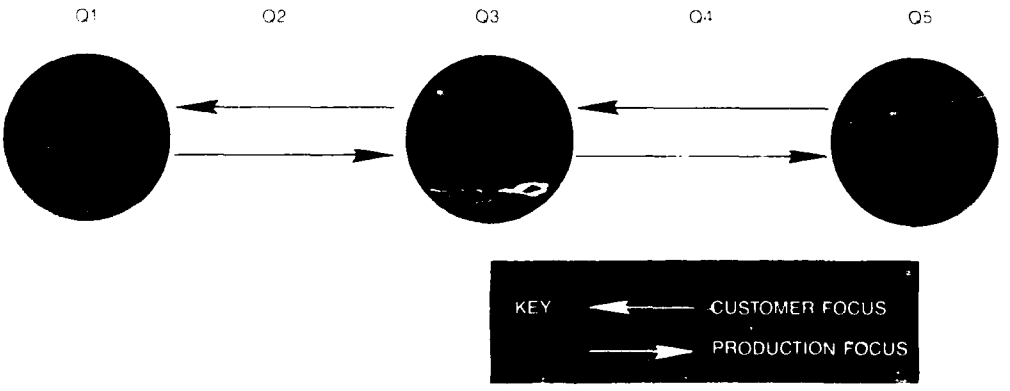
Q1 - *The selection and management of upstream systems* (i.e. suppliers, vendors, and customers). Focus on crossing boundaries, communication, clear and explicit expectations, specifications, cooperation, and coordination. Establish properly defined and documented *requirements*.

Q2 - *Incoming quality assurance*. Statistical quality control techniques. Ensure all inputs (labor, material, capital, energy, and data/information) received are the ones you've specified. Demand excellence. Manage conflict. Span boundaries and communicate expectations and desires. Emphasize quality of product and process design.

Q3 - *In-process quality management.* Emphasize continuous improvement of process, product, and service at all levels. Use statistical process control and methodology. Integrate design and manufacturing.

Q4 - *Outgoing quality assurance.* Ensure that products and services meet customer specifications. Inspect output aiming for improvement. Fix the problem, not the blame. Use statistical quality control techniques.

Q5 - *Management of downstream systems* (i.e. internal or external customers). Proactively and aggressively understand customer and market needs, expectations, and desires. Aim to solve a problem before it is a reality. Make an absolute commitment to customer satisfaction. Use performance feedback productively.



In the early 1950s, W.E. Deming told the Japanese that if they were to take some of the time, money, and resources devoted to Q2 and move them to Q1 and Q3, and take some of the time, money, and resources devoted to Q4 and move them to Q3 and Q5, three things would result: (1) improved quality would raise productivity; (2) they would capture the market with a lower price and better quality; and (3) they would stay in business and supply jobs. We've now seen roughly 35 years of data from this experiment. Deming was right!

Let's examine the stages of evolution you'll need to experience in order to effectively manage the five quality checkpoints.

Quality Must Be Managed Through Stages of Evolution

The concept of stages of evolution or maturity is well-developed in automation. The issue of step function improvements versus continuous improvements of a more incremental nature always arises. With automation, the evolution is seen as being more of a step function phenomenon while with quality management the steps to improvement may be shallower and more gradual.

Your Strategic Performance Improvement Planning Process, when applied to the quality function, will develop a Grand Strategy for quality management and will propel your organization to the Strategic Quality Management era faster than normal. We view the Strategic Performance Improvement Planning Process as a mechanism by which TQM becomes operational.

Over fifteen years of formal efforts to improve quality and productivity have convinced many managers that automation, just-in-time manufacturing, gainsharing, TQM, and other improvement strategies and initiatives will not be successful without effective management of participation. This is our next topic.

The Four Major Quality Eras

IDENTIFYING CHARACTERISTICS	STAGE OF THE QUALITY MOVEMENT			
	INSPECTION	STATISTICAL QUALITY CONTROL	QUALITY ASSURANCE	STRATEGIC QUALITY MANAGEMENT
PRIMARY CONCERN	DETECTION	CONTROL	COORDINATION	STRATEGIC IMPACT
VIEW OF QUALITY	A PROBLEM TO BE SOLVED	A PROBLEM TO BE SOLVED	A PROBLEM TO BE SOLVED, BUT ATTACKED PROACTIVELY	A COMPETITIVE OPPORTUNITY
EMPHASIS	PRODUCT UNIFORMITY	PRODUCT UNIFORMITY WITH REDUCED INSPECTION	THE ENTIRE PRODUCTION CHAIN FROM DESIGN TO MARKET AND THE CONTRIBUTION OF ALL FUNCTIONAL GROUPS TO PREVENT QUALITY FAILURES	THE MARKET AND CONSUMER NEEDS
METHODS	GAUGING AND MEASUREMENT	STATISTICAL TOOLS AND TECHNIQUES	PROGRAMS AND SYSTEMS	STRATEGIC PLANNING, GOAL-SETTING, AND MOBILIZING THE ORGANIZATION
ROLE OF QUALITY PROFESSIONALS	INSPECTION, SORTING, COUNTING, GRADING	TROUBLESHOOTING AND APPLICATION OF STATISTICAL METHODS	QUALITY MEASUREMENT, QUALITY PLANNING, PROGRAM DESIGN	GOAL-SETTING, EDUCATION AND TRAINING, CONSULTATIVE WORK, PROGRAM DESIGN
WHO HAS RESPONSIBILITY FOR QUALITY	INSPECTION DEPARTMENT	MANUFACTURING AND ENGINEERING	ALL DEPARTMENTS	EVERYONE IN THE ORGANIZATION WITH TOP MANAGEMENT EXERCISING STRONG LEADERSHIP
ORIENTATION AND APPROACH	"INSPECTS IN" QUALITY	"CONTROLS IN" QUALITY	"BUILDS IN" QUALITY	"MANAGES IN" QUALITY

(SOURCE: GARVIN, 1988, p. 38)

The Management of Participation: Some Theory

Things managers and leaders can and do control:

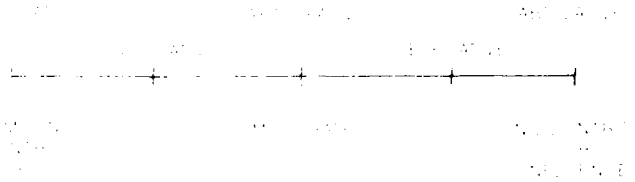
What We Manage, Influence and Control

Managers and leaders have the ability to influence many operational procedures in an organization. Typically, they have a greater ability to influence many operational procedures in an organization, more than they realize or practice. We used the words influence and control to make a point regarding how managers and leaders affect the factors listed to the left.

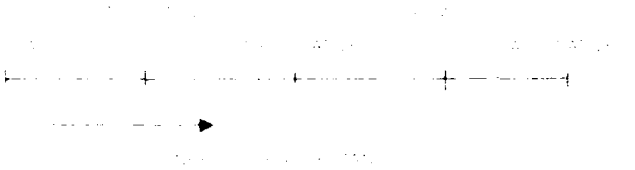
How We Manage and Lead

The style we utilize: the amount of control and influence we exert; and how we define appropriate and effective management and leadership behavior will vary from situation to situation. Management and leadership have become more complex, and require a wider range of behaviors.

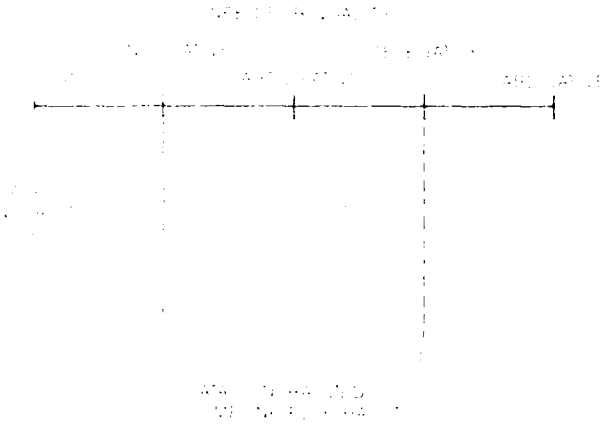
When is Management of Participation Appropriate?



In a simplistic sense, managers and leaders can exert varying amounts of control and influence over organized activity. We depict this in the scale to the left. The management literature represents points on this scale with a variety of terms; we have chosen terms that are commonly used. Note that these terms ought not be value-ladened (i.e., autocratic is not always bad, just as participative is not always good). The effectiveness of a management and leadership behavior depends on a variety of factors: the need for acceptance, the need for quality, the availability of time, and the developmental level of the followers (Blanchard and Hersey, 1982).



1. Need for Acceptance (N_A) – We know that the acceptance of a decision or solution to a problem by the people who will play a role in implementation is essential to effective, efficient, and quality results. Research and experience indicates that, as the perceived or real need for acceptance increases, managers should employ effective participative strategies.



2. Need for Quality (N_Q) – As the perceived or real need for quality in a decision or solution to a problem increases, it often causes managers to assume more control. The "I can do it best" attitude becomes prevalent. We think this is a trap. Deciding what management or leadership style to employ when the need for quality is high depends upon who has the data or information necessary to solve the problem or make the decision:

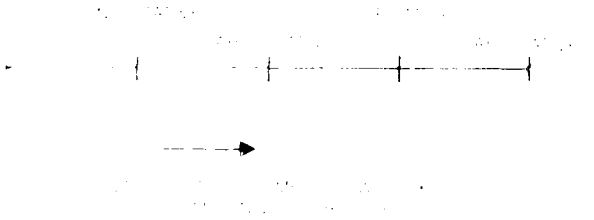
   a) If the data and information are centralized and you have them, it might be quite appropriate to "control" the decision or problem solving.

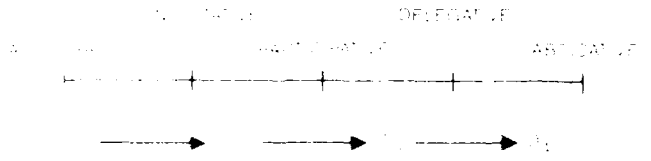
   b) If the data and information are centralized and someone else has them, it seems logical that you would want to consult with or delegate to that individual.

   c) If the data and information necessary to make the decision or solve the problem are dispersed (as is more often than not the case today), then a participative strategy will be more effective.

   The need for quality is a complex one, and requires judgment and discretion in terms of management and leadership style and behaviors.

3. Availability of Time – As the perceived or real time available to make a decision or solve a problem decreases, most managers and leaders are tempted to become more autocratic – to exert tighter control. Hidden in this temptation is a "Catch 22." We don't have time to let others participate in decision-making and problem-solving; we can do it better, quicker. As a result, we don't develop our subordinates, and confirm our hyphothesis about them and ourselves, thus creating a "reverse" Pygmalion effect. The critical issue with the factor of availability of time is accurate assessment and willingness to trade-off improved implementation, and perhaps quality, for what may be a more lengthy process.





4. Developmental level of the people you manage – Blanchard and Hersey (1982) have developed a simplistic, but effective categorization scheme which identifies four levels of development: (a) the D_1 employee or group is characterized as "low competence-high commitment"; (b) the D_2 employee or group as "some competence-low commitment"; (c) the D_3 employee or group as "high competence-variable commitment"; and (d) the D_4 employee or group as "high competence-high commitment."

Current management and leadership research, theory, and experience support the view that managers and leaders must assess the developmental level of their subordinates and management teams, and alter style and behavior accordingly. This assessment must be done on a task-by-task basis.

Management of Participation Theory in Summary

We have failed to effectively design, engineer, and develop our employee involvement efforts. As a result, they are failing to realize their full potential. The New Competition has a competitive edge because they are more effective at managing participation. The basics we presented above vary management and leadership style, and behave according to an assessment (informal as it may be) of four basic factors: (1) how much acceptance do I need to get this implemented? (2) what are my quality requirements? (3) how much time do we have? and (4) what is the developmental level of the individual or group relative to this task? These factors are critical to our ability to improve performance. Managing participation is an evolutionary process that is inextricably interwoven with culture and numerous other improvement strategies and techniques.

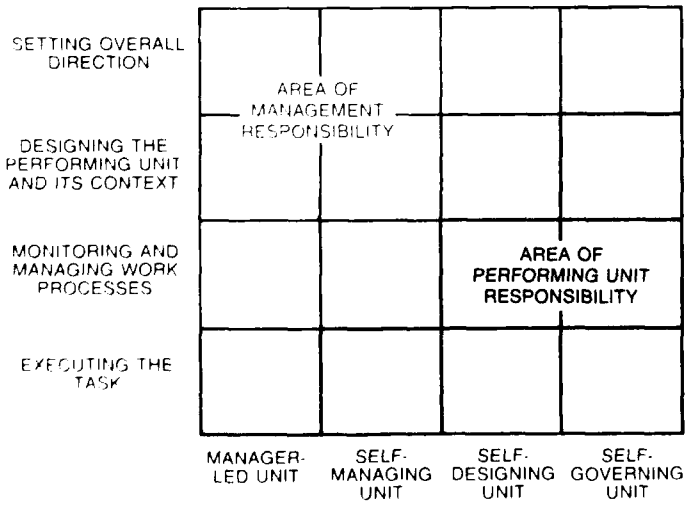
The Management of Participation: Moving from Theory to Practice

Effective management of participation requires:

- Moving the responsibility and accountability for planning, problem-solving, and decision-making to the lowest appropriate levels
- Learning how to share information, knowledge, power, and rewards (see Lawler, 1986; Kanter, 1983)
- Managing the transition from manager-led to *self-managing work groups*

Hackman (1986) views the evolution of management of participation in four stages. As we move from one stage to the next, performance reaches new levels, and responsibility and accountability for planning, problem solving, and decision making move to the lowest appropriate levels.

THE AUTHORITY MATRIX: CHARACTERISTIC TYPES OF PERFORMANCE



(SOURCE: HACKMAN, 1986)

BEHAVIORAL SIGNS OF SELF-MANAGEMENT

1. PERSONAL RESPONSIBILITY FOR WORK OUTCOMES
2. PEOPLE MONITOR THEIR OWN PERFORMANCE
3. PEOPLE MANAGE THEIR OWN PERFORMANCE
4. PEOPLE SEEK FROM THE ORGANIZATION THE ASSISTANCE THEY NEED FOR EXCELLENT PERFORMANCE
5. PEOPLE HELP PEOPLE IN OTHER AREAS IMPROVE THEIR PERFORMANCE WHEN THEIR OWN RESPONSIBILITIES ARE BEING MET

Form is not as important as:

1) The commitment to make management of participation work

2) Viewing management of participation as a continuously evolving process

3) Properly designing the effort

Experience suggests that the design specifications for improved processes in management of participation are as follows:

Design Elements of Effective Management of Participation Efforts

- QUALITY AND PRODUCTIVITY IMPROVEMENT PLANNING COMPONENT
- PARTICIPATIVE AND STRUCTURED PROBLEM SOLVING. NOMINAL GROUP TECHNIQUE USED TO SHAPE CONSENSUS
- FOCUSES ON EFFECTIVE IMPLEMENTATION
- STRESSES TEAM BUILDING, COMMUNICATION, COORDINATION, AND COOPERATION
- TOP DOWN IMPLEMENTATION
- PROCESS IS SYSTEMATIC, STRUCTURED, STRAIGHTFORWARD
- TRAINING AND RETRAINING AS NEEDED BASIS
- FOCUSES ON PERFORMANCE
- STRONG EMPHASIS ON MEASUREMENT AND EVALUATION SYSTEMS FEEDBACK
- FORCES SHARING OF INFORMATION. STRESSES GETTING THE RIGHT INFORMATION TO THE RIGHT PEOPLE AT THE RIGHT TIME
- SHARES POWER APPROPRIATELY
- SHARES KNOWLEDGE
- CONTINUING PROFESSIONAL DEVELOPMENT AND COLATERAL TRAINING AND EXPERIENCE ARE CRITICAL
- TOP MANAGEMENT INVOLVEMENT, SUPPORT AND LEGITIMIZATION

(SOURCE: SINK, 1985)

Musashi Semi-Conductor Works is an example of an organization that showed commitment, invoked a continuous improvement orientation, and designed the process properly. As a result of improved design and execution, more patience, better foundation laying, higher quality commitment and understanding from top management, they have achieved a competitive edge in this key performance area.

COMPARISON OF MUSASHI'S SMALL GROUP ACTIVITY AND QUALITY CIRCLES PERFORMANCE

	SMALL GROUP ACTIVITY	U.S. QUALITY CIRCLES
DEVELOPMENT TIME	5 YEARS	5 MONTHS
SCOPE OF INVOLVEMENT (DEFINITION OF EMPLOYEES)	EVERYONE	LINE SUPERVISORS, BLUE COLLAR WORKERS, CLERICAL STAFF
FOCUS OF IMPROVEMENT	PERFORMANCE	QUALITY
PROPOSALS DEVELOPED (PER GROUP PER YEAR)	100-600	1-10 (TYPICALLY SUGGESTIONS)
PERCENT IMPLEMENTED	80-90	10-50
EVALUATION CRITERIA	CONSTANT IMPROVEMENT IMPLEMENTATION EFFECTIVENESS TOTAL INVOLVEMENT QUALITY OF PROCESS	BENEFIT-TO-COST RATIOS SHORT TERM PAYOFF

(SOURCE: DAVIDSON, 1982; SINK, SHELTZER AND MARION, 1986)

You'll know you've succeeded in managing participation when your new management processes become a way of doing business and no title is needed for the effort.

Let's now take a look at a technique useful for managing participation, the Nominal Group Technique.

Nominal Group Technique: A Method for Gaining Consensus

A widely used, and tried and tested technique for managing participation in such processes as planning, performance improvement, and measurement is the Nominal Group Technique (NGT).

The NGT is a structured, small-group process that is an effective and efficient way to collect data from people while encouraging them to reach a consensus. The technique is effective with all types and levels of employees, and can be used in a wide range of settings and applications.

- To increase the quality, effectiveness, and efficiency of group processes that play a significant role in the overall success of quality and productivity improvement efforts.
- To generate a prioritized consensual list of measures and improvement interventions.
- To help screen unworkable ideas (suggestion systems don't).
- To inspire a commitment to action, follow-through, and follow-up.

We are going to describe this technique in some detail because it can be an integral part of your efforts to plan for performance improvement and to measure performance.

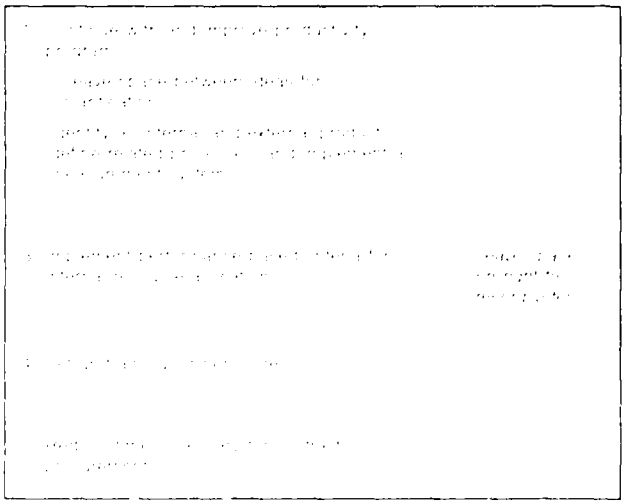
Example Task Statements

Identify roadblocks to quality and productivity improvement.

Identify measures of performance that will tell us how well we are doing and/or if we are improving.

Identify what we can do to improve quality and productivity during the next year.

Sample Flip Chart Page
After Step 2



Precondition – You must have the right people at the session, ask the right questions, and use the right process. There are also a number of logistical issues that must be addressed (see Delbecq, Van de Ven, and Gustafson, 1986).

Step 1 – Silent Generation. The facilitator hands each participant a sheet of paper with a task statement written at the top. The facilitator then verbally presents the task statement, and asks the participants to silently and independently respond in writing. Step 1 typically takes 5 to 15 minutes, or until one or two participants are left writing.

Facilitator Guidelines:

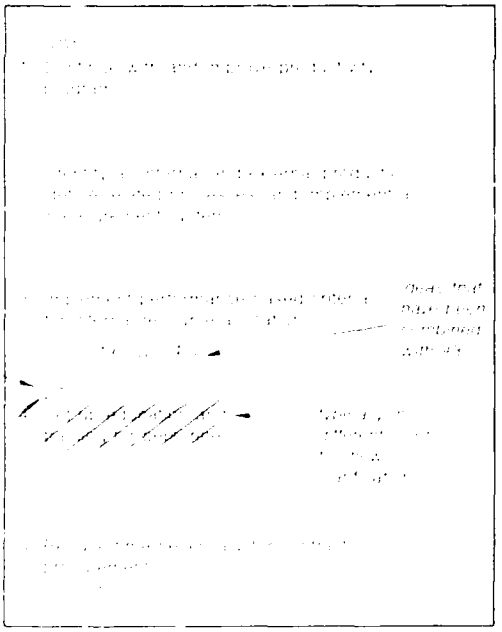
- Put the task statement in writing.
- Let the group give some practice responses if there are questions about the task statement
- Avoid cutting off the silent generation period too early – good ideas take time.

Step 2 – Round Robin. The facilitator asks each participant for one idea and records it on a flip chart. This process continues in a round robin fashion (one idea per person per round) until all the ideas have been recorded. Step 2 typically takes 15 to 25 minutes, depending on the number of participants.

Facilitator Guidelines:

- Ask participants to give concise answers and to not evaluate others' answers.
- Record responses accurately
- Maintain the pace

Sample Flip Chart Page
After Step 3



Step 3 – Group Clarification of Ideas. In Step 3, the group needs to accomplish five things:

1) Clarify unclear ideas.

2) Modify ideas when appropriate.

3) Combine or merge similar ideas.

4) Add ideas if need be.

5) Delete ideas if need be.

The desired outcome of Step 3 is to have a "cleaned-up" list of ideas and to ensure that everyone has an understanding of each idea. Step 3 is the most difficult step of the NGT to facilitate and requires 20-30 minutes, depending on the size of the list.

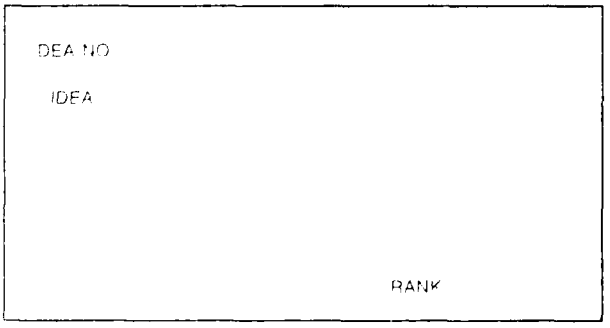
Facilitator Guidelines:

- Know when to be decisive to maintain the pace.
- When in doubt, don't combine or delete.
- Look for hierarchies of ideas and decide the level at which responses should be – avoid combining everything into 5 or 10 categories.

Step 4 – Voting and Ranking. In Step 4, the facilitator hands out 7 voting cards (use 5 cards for 15-20 ideas and 9 cards for more than 30 ideas). Participants are asked to identify the 7 most important ideas and to record one on each card. When this is complete, you are ready to execute the voting procedure:

- Have participants spread out the cards.
- Tell them to give the most important idea a "7" and then flip the card over.
- For the remaining 6 cards, tell them to give the least important idea a "1" and then flip the card over.
- Repeat the above two steps for the remaining cards (adjust rank accordingly). This "outside in" ranking process is important.

EXAMPLE 3 IN. X 5 IN. VOTING CARD



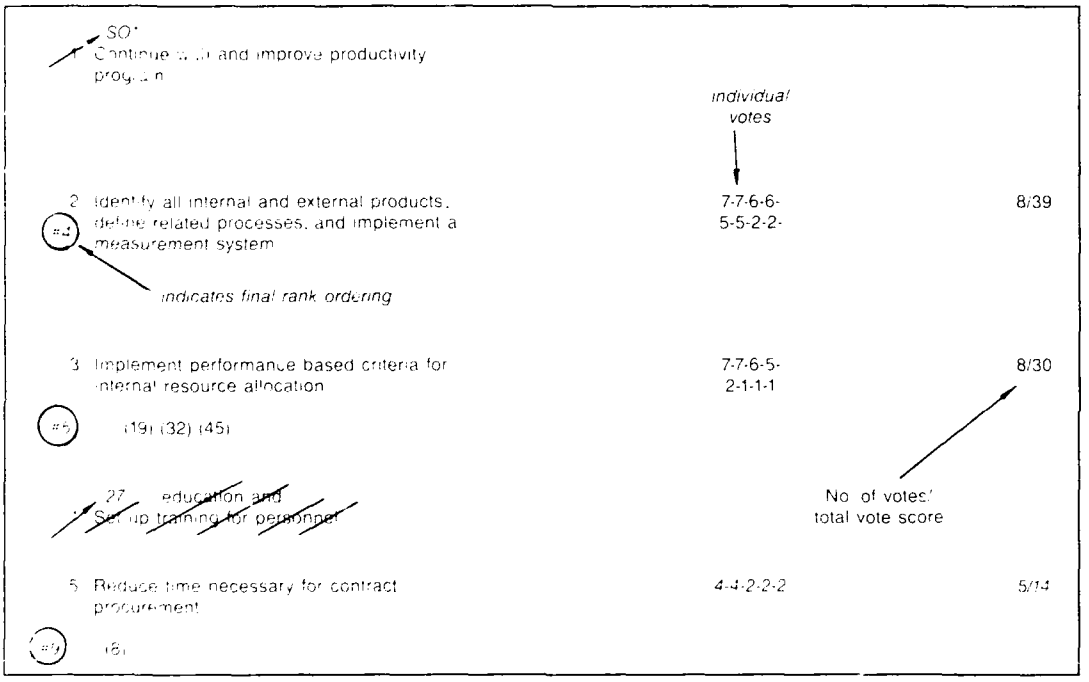
Facilitator Guidelines:

- Allow ample time for selecting ideas and ranking.
- Walk participants through the voting and ranking process.
- Do not allow breaks at this point.

Compilation of Voting Results:

- Stack ideas by idea number.
- Record votes for each idea on the flip chart (use a different color marker).
- Add up the total score for each idea.
- Rank ideas and announce the top ideas.

Sample Flip Chart Page
After Step 4



Step 5 - Discussion of Results. The facilitator should encourage discussion of the results, and participants are instructed to make plans for a follow-through. Results should be typed and distributed to participants.

For more on the NGT, we highly recommend *Group Techniques for Program Planning* by Delbecq, Van de Ven, and Gustafson (1986), the developers of the NGT.

When we began this chapter, we spoke of five major improvement strategies: (1) planning, (2) management, (3) quality management, (4) management of participation, and (5) reward systems. Planning and measurement are the topics of Chapters 3 and 5 respectively. We have just completed our discussion of quality management and management of participation. The last area to be discussed is reward systems. We suspect that the compensation management practices and processes in the A&D Contractor of the Future will incorporate forms of performance gainsharing. We also suspect that government-to-contractor performance improvement gainsharing will continue to evolve. This is the topic of the last section of this chapter.

Gainsharing: Company to Employees

Gainsharing plans have been around for nearly 50 years. In a gainsharing plan, weekly, monthly, or quarterly plant performance level is measured and compared to an historical or established performance benchmark. If the current period's performance exceeds this benchmark, the resulting dollar gains due to this improvement are shared. Gainsharing differs from profit sharing in four ways. First, gainsharing typically measures controllable costs, not all costs, in calculating a bonus. Second, gainsharing is typically applied at the plant level, while profit sharing is applied at the division or corporate level. Third, gainsharing uses a performance benchmark while profit sharing typically just sets aside a percentage of profit for sharing. Fourth, gainsharing is applied on a weekly, monthly, or quarterly basis; profit sharing is typically awarded annually.

Gainsharing: When to Use it and Why

Once an organization has reached or exceeded reasonably impressive levels of performance, they will need to address several issues involving how to maintain the following:

- Motivated levels of performance on the part of everyone in the organization
- High levels of proactivity with regard to innovation for quality and productivity improvement

Improvement

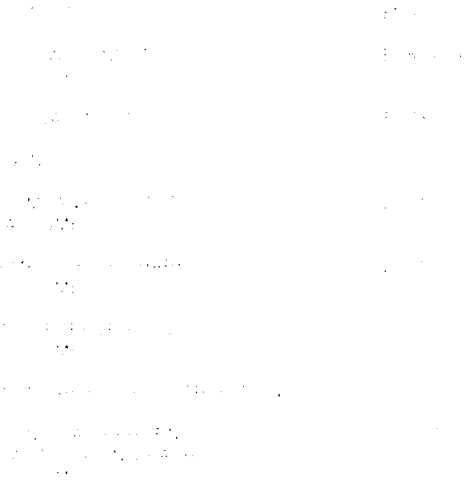
- A sense of organizational commitment and ownership
- High levels of communication, coordination, and cooperation within and between organizational systems
- Progress towards improving the quality of management, work, and life.

Gainsharing, then, is best applied as a later stage intervention in quality and productivity efforts. It can help an organization maintain high levels of performance, proactivity and innovation, and organizational commitment, as well as improving communication, cooperation, and coordination.

Types of Gainsharing Plans

There are three types of gainsharing: productivity gainsharing, cost-based or profit-based gainsharing, and performance-based gainsharing.

Example Productivity Gainsharing Calculation



1) *Productivity Gainsharing.* Productivity gainsharing shares gains as a reward for productivity improvement. An historical or established input:output ratio is used to determine the allowed input for a given level of output. If actual input valued in base year, not current year, dollar amounts is less than the allowed input, there is a gain (i.e., productivity improved over the base). Quite often, reserve pools are used to protect the company during periods when productivity declines. The figure to the left depicts an example productivity gainsharing calculation. The Scanlon, Rucker, and Improshare Plans are examples of productivity gainsharing plans.

   Productivity gainsharing plans can be one of three types: partial factor, multifactor, and total factor. Partial factor gainsharing involves a single class of inputs (labor, capital, materials, or energy). Multifactor gainsharing considers more than one input class, but not all input classes. Total factor gainsharing occurs when all classes of inputs are considered. Total factor approaches are considered the best possible base for gainsharing because they alone reward true, bottom line productivity gains. Many organizations start with a partial factor approach and evolve toward a total factor approach as they become more experienced with the practice.

Productivity Measures Used in Common Productivity Gainsharing Plans

SIMPLE SCANLON	SPLIT RATIO SCANLON	MULTI-COST SCANLON	RUCKER	IMPROSHARE
LABOR COSTS	LABOR COSTS BY PRODUCT	LABOR, MATERIALS, AND OVERHEAD	LABOR COSTS	ACTUAL HOURS
SALES VALUE OF PRODUCTION	SALES VALUE OF PRODUCTION	SALES VALUE OF PRODUCTION	VALUE ADDED	TOTAL STANDARD HOURS PRODUCED
WHERE SVP EQUALS SALES LESS RETURNS AND ALLOWANCES CHANGED IN INVENTORY			WHERE VALUE ADDED EQUALS SVP LESS MATERIALS, SUPPLIES, AND PURCHASED SERVICES	USES A BASE PRODUCTIVITY FACTOR TO ADJUST STANDARDS FOR PAST ACTUAL OUTPUT

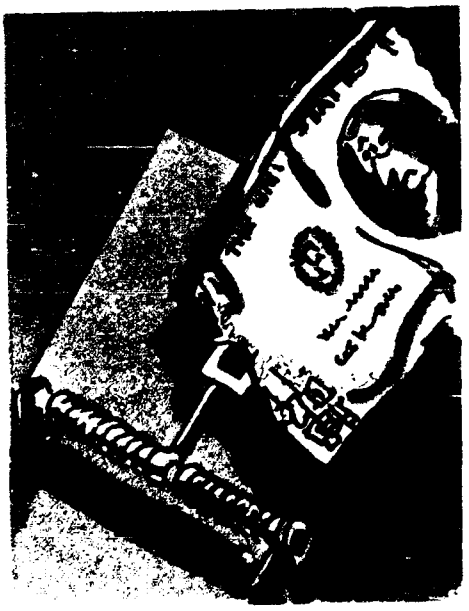
COMPANY	FAMILY OF MEASURES
MOTOROLA'S GOVERNMENT ELECTRONICS GROUP	PRODUCTION COST QUALITY DELIVERY INVENTORY SAFETY OTHER MEASURES FOR ADMINISTRATION AND TECHNICAL
MOBAY CHEMICAL	TOOL AND SAFETY SUPPLY USAGE SALVAGE AND REUSE SAVINGS ENERGY USAGE SAVINGS GENERAL SUPPLY USAGE IRON OXIDE REACTOR TIME SAVING IRON OXIDE MILLING RECYCLE REDUCTION WASTEWATER TREATMENT COST ENVIRONMENTAL CONTROL • SOLID WASTE DISPOSAL POLYURETHANE AREA ERROR REDUCTION COMPOSITE PERFORMANCE INDEX FOR POLYURETHANE AREA
KNOLL INTERNATIONAL (FURNITURE MANUFACTURER)	MONTHLY SHIPMENTS RETURNS INVENTORY TURNS ON-TIME DELIVERIES FACTORY PERFORMANCE EMPLOYEE PARTICIPATION SUGGESTIONS
INGERSOL-RAND ROCK DRILL DIVISION	INVENTORY TURNS QUALITY PERFORMANCE REDUCING VARIANCES REDUCING OVERHEAD

2) *Cost-Based or Profit-Based Gainsharing.* These programs are similar to productivity gainsharing with the exception that changes in output prices and input costs influence the gainsharing calculation. Scanlon and Rucker Plans that calculate bonuses using current period prices and costs are examples of cost-based gainsharing. Note that a positive change in productivity can be offset by a negative change in price recovery and vice versa. Companies that use a cost-based gainsharing plan need to be sure that output prices and input costs do not fluctuate widely and that they have communicated the productivity-price recovery relationship to employees.

3) *Performance Gainsharing.* This approach, often referred to as the "family of measures" approach, has been growing in popularity in recent years. Performance gainsharing measures and rewards performance improvement (i.e., effectiveness, efficiency, quality, productivity, innovation, quality of work life, and profitability (for profit centers)/budgetability (for cost centers)). Measures of performance are developed and tied to a gainsharing fund. Examples of performance gainsharing plans are shown in the figure at the left.

Let's take a look at how gainsharing fits into an organization's quality and productivity management efforts.

Gainsharing: May Not be Appropriate Early in Quality and Productivity Management Efforts



Gainsharing has strategic implications. Everyone doing his or her best in a system that hasn't defined what the right things are will just make things worse.

Why pay for something you should already be getting? If an organization is not performing at acceptable levels, and it institutes gainsharing, any performance improvement realized up to acceptable performance levels is performance the organization is paying for with both base pay and gainsharing. Gainsharing is not needed to achieve acceptable, or even motivated performance levels.

Motivation is not equal to performance. Performance is motivated by at least four factors: 1) knowing what is expected and required; 2) having the ability to do what is required; 3) being motivated to do what is required; and 4) working in an environment which allows you to do what is required.

Money can motivate but has traps for the unwary or unsophisticated. Money does not have the simple psychological effects on motivation and performance that are evident at first glance. Money may adversely effect intrinsic motivation.

The informal reward system is as powerful, if not more powerful, than the formal reward system. A frequently cited roadblock to improvement is the "lack of incentives to improve"; when we ask people what they mean by this, money is seldom, if ever, mentioned, while the informal reward system is (*i.e., what behaviors are rewarded, sanctioned,* and punished).

There is a difference between organizational commitment and attachment. You can buy attachment – it's merely a function of benefits and costs. Managing to elicit commitment, on the other hand, is much more complex and involves more than changing the way people are rewarded.

There is no such thing as a "free lunch." If gainsharing is implemented in the absence of a quality performance management effort, the psychological and sociological costs may far outweigh any short-term gains.

The management of participation is critical to gainsharing success. Participative management has been identified as a key component to gainsharing success. Most U.S. organizations are failing to manage participation.

Gainsharing is not a mutually exclusive alternative. Reward systems in the organization of the future will have to look more like those used in sales and marketing which use a blend of different types of rewards. Gainsharing must not be viewed as a simple answer to a complex issue but rather as a component of an overall system.

Gainsharing requires you to be a chef (i.e., designer and engineer), not a cook. Gainsharing plans implemented off-the-shelf will, more than likely, fail.

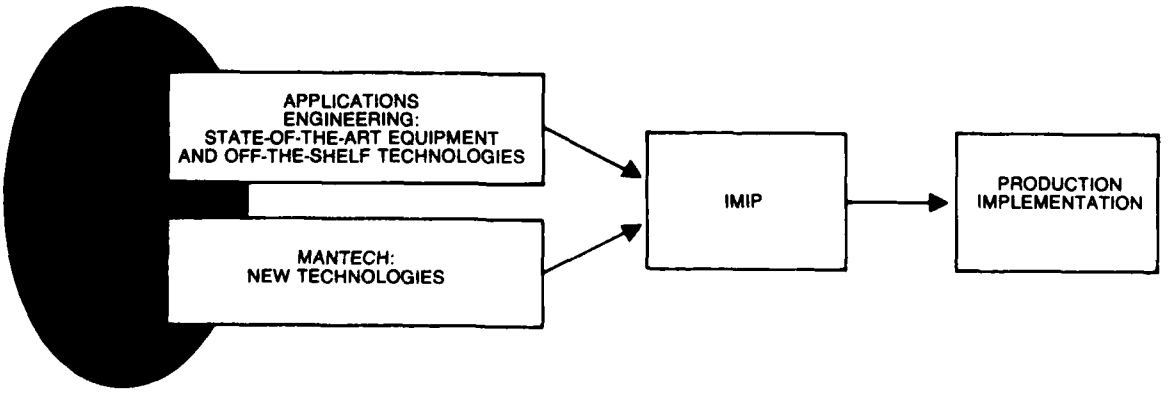
Let's move away from contractor-to-employee gainsharing and toward government-to-contractor gainsharing. Government-to-contractor gainsharing is a key improvement strategy used to promote the modernization needed to better manage quality and productivity.

Gainsharing: Government-to-Contractor Incentives through The Industrial Modernization Incentives Program

What Is It?

The Industrial Modernization Incentives Program (IMIP) is a joint venture of the government and industry designed to accelerate the implementation of modern equipment and management techniques in the industrial base. These programs are implemented where competitive market forces are insufficient to bolster independent contract modernization. They are also used when significant benefits, such as cost reduction, elimination of production bottlenecks, improved quality and reliability, and improved surge capability can be expected to accrue to the government.

IMIP projects can make use of both new and existing technology.
(Source: DOD Guide 5000.44-G)



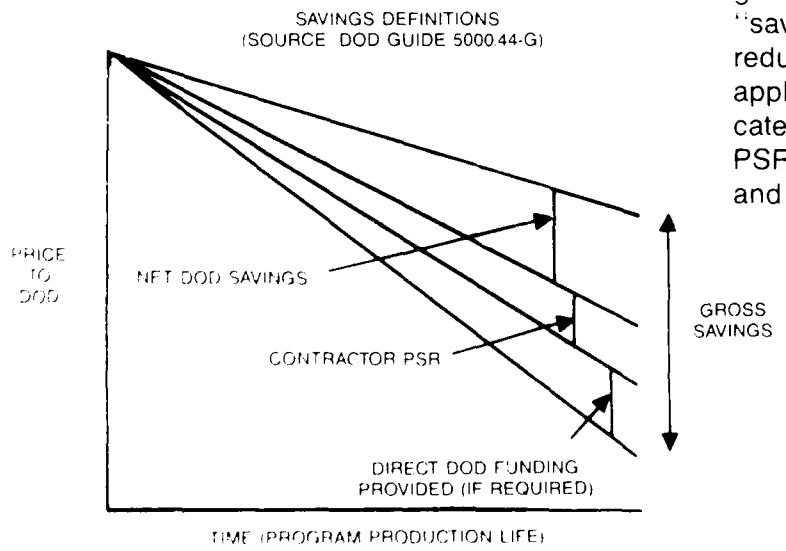
Improvement

Why Use It?

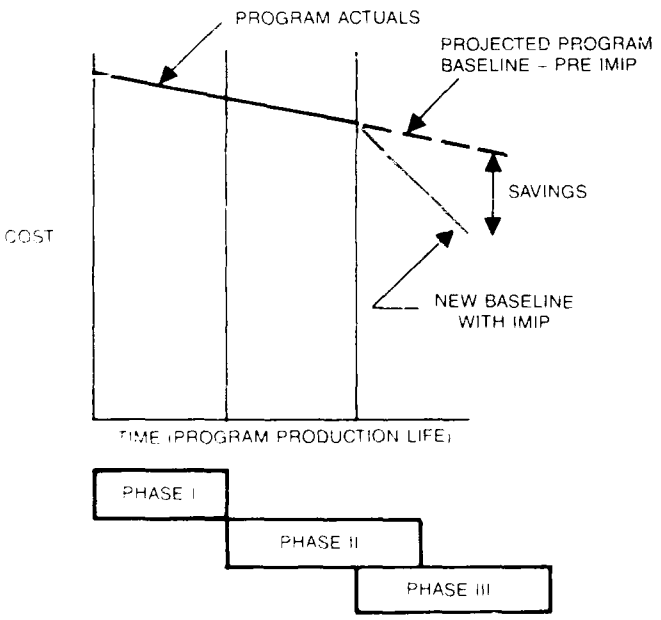
- To create win-win situations for the government and the contractor
- To reduce costs and lead times
- To improve quality and productivity
- To help foster a strong industrial base to meet surge and mobilization requirements

How Does It Work?

The primary incentive under the IMIP is the Productivity Savings Reward (PSR), but other incentives, such as award fees and direct government funding, are also available. Contractor investment protection may be available as an incentive under certain circumstances, but it requires approval beyond the IMIP negotiations. The portion of the IMIP savings and/or cost avoidances earned by the contractor is referred to as a PSR. The IMIP government benefits are referred to as "savings" when current contract prices are reduced and as "cost avoidances" when they apply to contracts yet to be priced. Two basic categories of contractor projects qualify for a PSR: Modernization Investment Projects (MIPs) and Modernization Efficiency Projects (MEPs).



IMIP CONCEPT AND SEQUENCE OF ACTIVITIES
(SOURCE DOD GUIDE 5000.44-G)



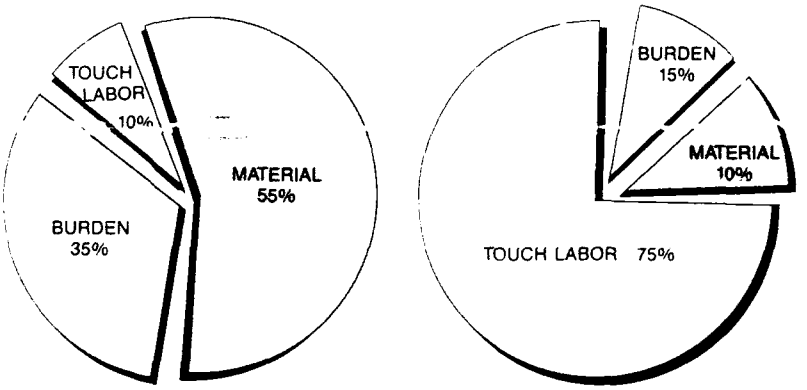
The primary IMIP emphasis is on MIPs, which are heavily dependent on capitalized contractor investments. For MIPs, the contractor's PSR is determined by means of an Internal Rate of Return analysis and evaluation, using the Discounted Cash Flow/Shared Savings Approach Model (see Chapter 5).

The MEPs enhance contractor productivity without requiring significant capital investment. Examples include projects for plant rearrangement, overhead cost reduction, and integration of management information systems. For MEPs, the contractor's PSR is based primarily on the percentage share of the net savings realized for benefits that are substantial, verifiable, and an integral part of an IMIP proposal. The contractor's share of net savings is determined according to the profit effects due to a reduced contractor cost base.

An IMIP will normally be accomplished in three phases, after a preliminary determination by the government and contractor that there are benefits to be gained by both parties. These three phases are incorporated into the 10-stage quality and productivity management methodology presented at the end of Chapter 5. Phase I is Factory Analysis/Project Identification (this phase corresponds to Stages 1 - 3). Phase II is Project Design/Development (Stages 5 - 8). Phase III is the Implementation Phase (Stages 9 and 10).

Where Can Modernization Efforts Be Focused?

Maximum productivity gains result from matching improvement efforts to cost drivers. Quite often, this is not the case in a typical A&D contractor.



WHERE THE COSTS ARE

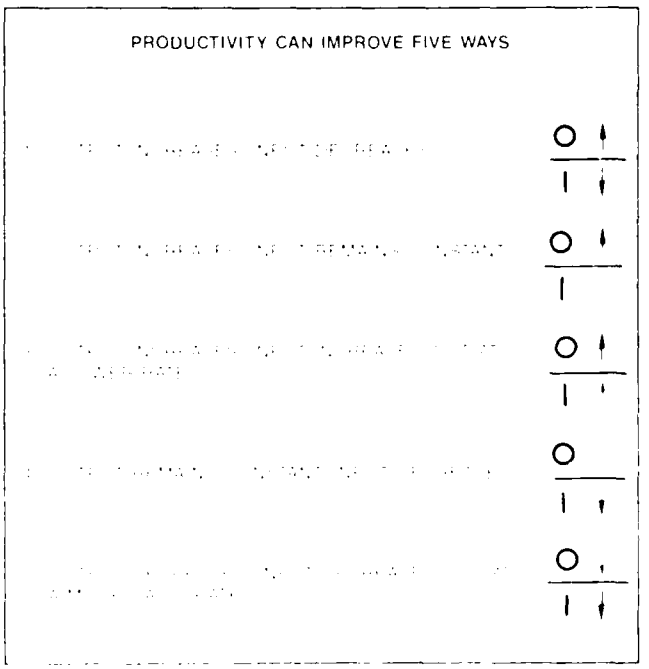
WHERE WE FOCUS COST REDUCTION AND MODERNIZATION EFFORTS

(SOURCE: CAM-I STUDY, 1988)

Improvement

Single-minded attention to direct labor made sense in the days when labor represented a large percentage of total costs. But today, such attention can produce unintended consequences. Labor, capital, and material are all potential trade-offs for each other; this is a notion that almost precludes joint productivity improvement. Productivity increases and decreases can be passed from one input class to another without changing the bottom line, total factor productivity.

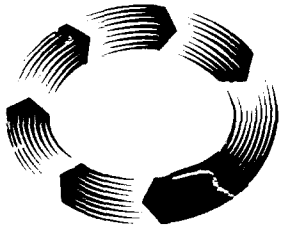
Modernization efforts that are matched to cost drivers produce the greatest performance improvement benefits. Sharing the gains of this performance improvement with the contractor is a good business practice.



Improvement

Summary

Designing and managing quality and productivity improvement is not easy. It requires patience, persistence, consistency, and effective implementation. This chapter and the previous chapter on planning have, hopefully, provided a foundation on which to build effective quality and productivity efforts. We will next examine the role of measurement in (your) improved management processes and systems. Measurement itself can be a source of improvement. More importantly, it plays a critical role linking quality and productivity management efforts. Measurement tells us whether the improvement interventions we've made are having the impact we thought they would or should have on performance and helps us determine targets for further improvement interventions.



Measurement

Chapter 5
Theory, Approaches, and Techniques

Key Points:

1. You can't manage what you can't measure. (p. 74)

2. The primary purpose of measurement is to support continuous performance improvement.

3. Improvement-oriented measurement systems are team designed, developed, and maintained. (p. 79)

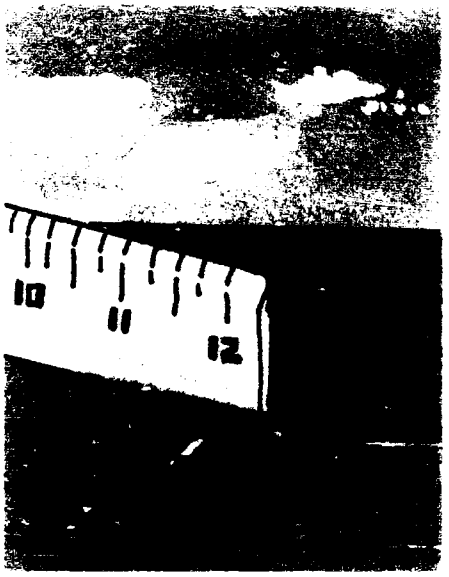
4. We present two systematically structured approaches for building improvement-oriented measurement systems: Management Systems Analysis (p. 85) and The General Measurement Methodology. (p. 89)

5. As part of these structured approaches we present state-of-the-art and practice measurement techniques that must be learned, experimented with, and implemented to support continuous improvement. (pp. 96, 124)

6. Today's managers in A&D have the challenge of building improved measurement systems (instrument panels) (p. 128)

Measurement

Measurement is an Important Part of Quality and Productivity Improvement



If you don't measure, how will you know if you are:

- Getting the job done within specifications?
- Meeting your long-range needs?
- Improving fast enough?

You will know only if you have properly designed and executed measurement and *evaluation systems.*

The importance of measurement is captured in the "essence of management" passage:

"You cannot manage what you cannot measure. You cannot measure what you cannot operationally define. You cannot operationally define what you do not understand . . . You will not succeed if you do not manage."

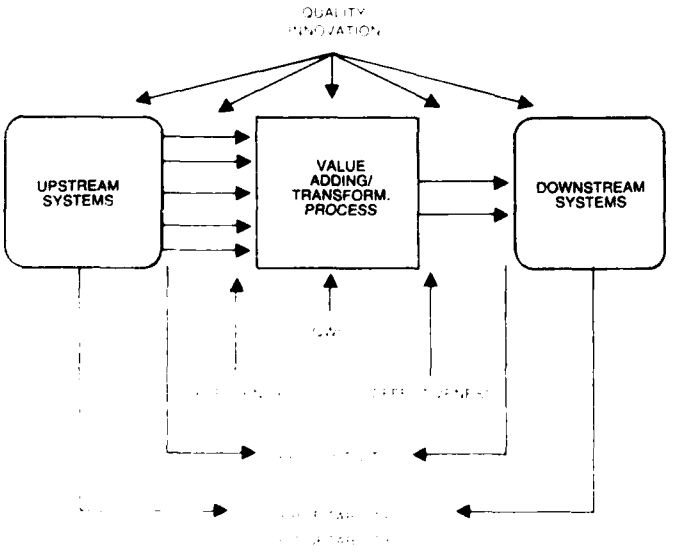
Measurement

Theory: Some Fundamental Concepts

Where to Measure? – Definition of Target System

The target system or unit of analysis being measured must be precisely defined in order to avoid confusion. The target system defines the boundaries of the system being measured. Examples of target systems include an individual, a group, a department, a function, a plant, a division, or a company. One of the most significant problems causing difficulty with measurement is an inability or unwillingness to define the target system.

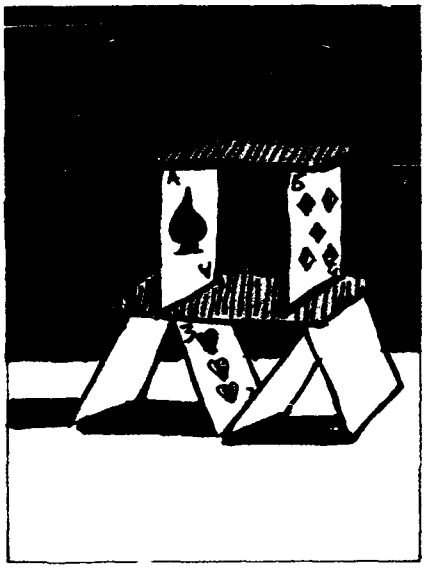
What to Measure? – Measuring Performance



Performance is a function of effectiveness, efficiency, quality, productivity, quality of work life, innovation, and profitability (for a profit center)/budgetability (for a cost center). These seven criteria form the basis for designing a measurement and evaluation system, and in order to be effective, the definitions and importance of each criterion must be understood and accepted by all.

1) Effectiveness is the degree to which the system achieves what it set out to accomplish. In equation form, it is equal to actual output over expected output (AO/EO). Quality and timeliness are important attributes of effectiveness.

2) Efficiency is the degree to which the system used the "right" resources in the right way. In equation form, it is equal to resources planned or expected to be consumed over resources actually consumed (REC/RAC)



3) Quality must be examined and defined relative to five quality checkpoints to be fully understood and appreciated (see Chapter 4 for more on quality):

   Checkpoint 1: Selection and management of upstream systems
   Checkpoint 2: Incoming quality assurance
   Checkpoint 3: In-process quality management
   Checkpoint 4: Outgoing quality assurance
   Checkpoint 5: Proactive and reactive assurance of customer satisfaction

4) Productivity is the relationship between quantities of outputs from a given system and quantities of inputs (labor, capital, material, and energy) into that system. In equation form, it is equal to output over input (O/I). Note that quality is an attribute both in the numerator and denominator of the productivity equation.

5) Quality of work life (QWL) is the measure of how people feel about such things as their job, benefits, working conditions, boss, pay, and co-workers. Job satisfaction, turnover, absenteeism, and organizational commitment are example attributes of QWL.

Measurement

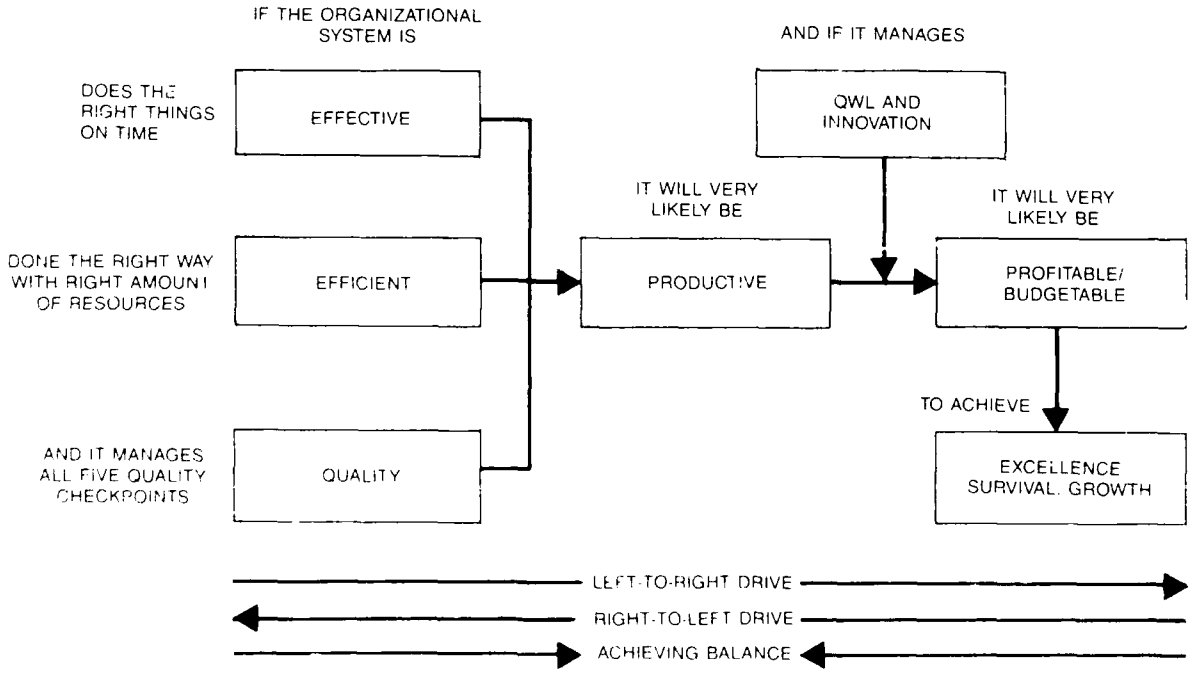
6) Innovation is the creative process of changing products, services, and processes to successfully respond to or anticipate internal and external changes.

7) Profitability is the set of measures that examines the relationship between revenues and costs. Profitability is achieved through price recovery and productivity gains. Budgetability is the set of measures that examines the relationship between budgets and actual costs. Budgetability is achieved through meeting goals within budget.

"By their very nature financial analysts tend to be defensive, conservative, and pessimistic. On the other side, guys in sales and marketing are aggressive, speculative, and optimistic. They're saying let's do it, while the bean counters are cautioning why you shouldn't. If the bean counters are too weak, the company will spend itself into bankruptcy. But if they are too strong, the company would not meet the market or stay competitive. In a company you need both sides of the equation."

– Lee Iacocca, in *Iacocca: An Autobiography*

This model depicts visually what Iacocca states in words. The short-term financial and budgetary pressures we face every day cause us to drive the equation right-to-left, looking first at what are acceptable levels of profit, return, and payback, and then at what levels of effectiveness, efficiency, and quality are affordable. On the other hand, longer term survival, competitiveness, and quality issues tend to cause us to drive the equation left-to-right, focusing on the levels of effectiveness, efficiency, and quality needed to remain ahead of the competition. A problem we have in most U.S. organizations is that the source of right-to-left drive (the comptroller) is strong and powerful, while the source of left-to-right drive (the planning department) is weak or non-existent. For example, we quite often let our budget drive the plan, not vice-versa. The challenge then is how to create a better balance. The Planning Process discussed in Chapter 3 is designed to help you create better balance.



THE INTERRELATIONSHIP AMONG ORGANIZATIONAL PERFORMANCE CRITERIA

Measurement

Characteristics of Effective Measurement Systems

Good performance measurement and evaluation systems all:

- Relate directly to what constitutes performance
- Are simple (7 ±2 measures), yet effective.
- Provide a good scoreboard (evaluate and motivate improvement)
- Are team maintained
- Are flexible, adaptable, and dynamic

WHY MEASUREMENT SYSTEMS FAIL

- FAILURE TO THINK (AND OPERATIONALLY DEFINE) WHAT PERFORMANCE MEANS FOR THE SYSTEM
- IMPROPERLY DEFINING SYSTEM BEING MEASURED
- MISUNDERSTANDING OR MISUSING MEASURES
- FEAR OF EXPOSING POOR PERFORMANCE AND FEAR OF EXPOSING GOOD PERFORMANCE
- CONSUMPTION OF TIME AND REPORTING
- FEAR OF LOSING AUTONOMY
- MEASURING A WHILE HOPING FOR B

Measurement

Multiple Measures and Measurement Systems

You can't rely on one measure or system to capture the performance of the complex system you manage. The best measurement systems are a blend of subjective and objective, qualitative and quantitative, explicit and implicit, hard and soft, and physical and social.

Separate Measurement from Evaluation

Measurement is the act or process of determining the qualities and dimensions of the target variable.

Evaluation is the act or process of determining the significance or value of the target variable by careful appraisal and study.

Examples of measurement:

Correct	Incorrect
Cost	Reduce cost
Productivity	Improve productivity 25 percent
Rework labor hours	Minimize rework labor

Measurement must be kept separate from evaluation in order to drive and promote constant improvement.

Measurement

Measurement and Evaluation Systems Should be Designed Like a Piece of Equipment

A measurement system should be designed to do the following:

- Operate on a target system in specific situations
- Respond to the needs of the manager, management team, or workers
- Support continuous improvement as well as control needs via separate systems

Guidelines for Planning a Measurement Design/ Redesign Effort

- Plan for improved measurement and evaluation systems with the same attention to detail that is used in budget planning.
- Plan and design to involve the people who are part of the system being measured.
- Use measurement to support improvement

Constant Improvement

To achieve the desired outcomes of measurement, decide participatively what to track; decide how to operationalize each measure and collect data, and track it over time.

To achieve the desired outcomes of evaluation, establish benchmarks of performance with an eye toward constant improvement; validate measurement and data collection; determine the best way to present the data; and involve people in the evaluation process.

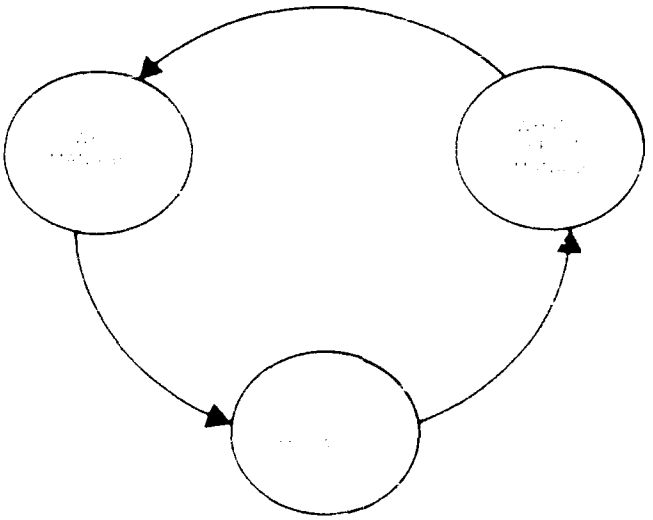
To achieve the desired outcomes of control and improvement, take action and involve the people in the control and improvement process.

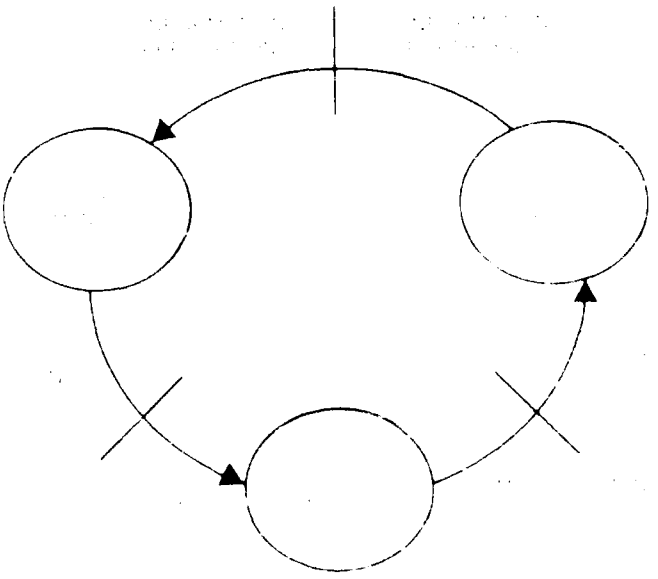
Approaches to Improve Measurement and Evaluation System Quality

Understand Management Systems to Better Design Measurement Systems

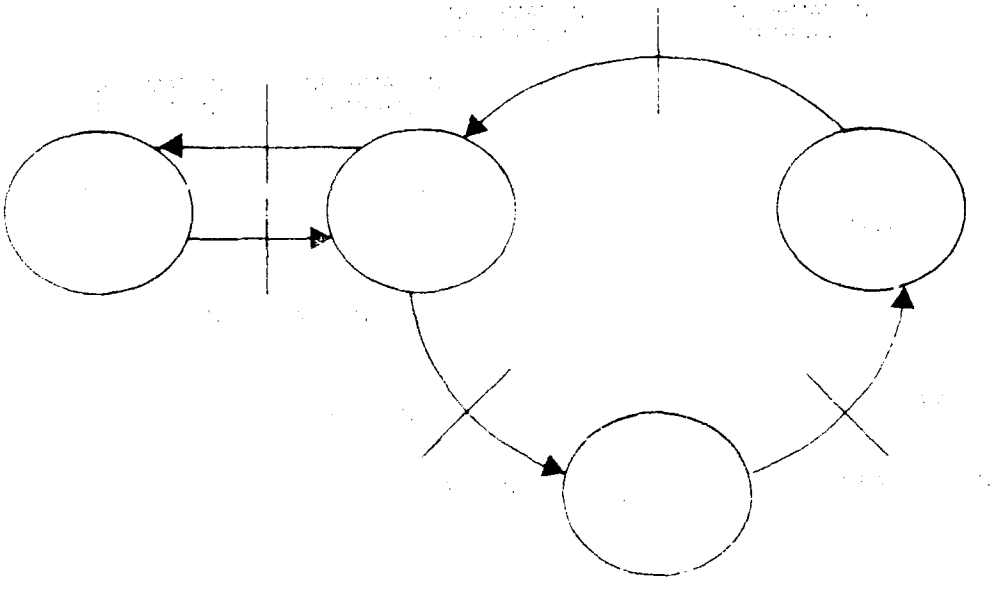
An understanding of what is meant by the term "management system" is required in order to effectively design and engineer measurement systems. The Management Systems Model, developed by Kurstedt (1985), helps us gain this understanding. The model depicts the elements of and critical interfaces between the components of a management system. The model also provides insight into the steps required to design better measurement systems.

A MANAGEMENT SYSTEM HAS THREE COMPONENTS





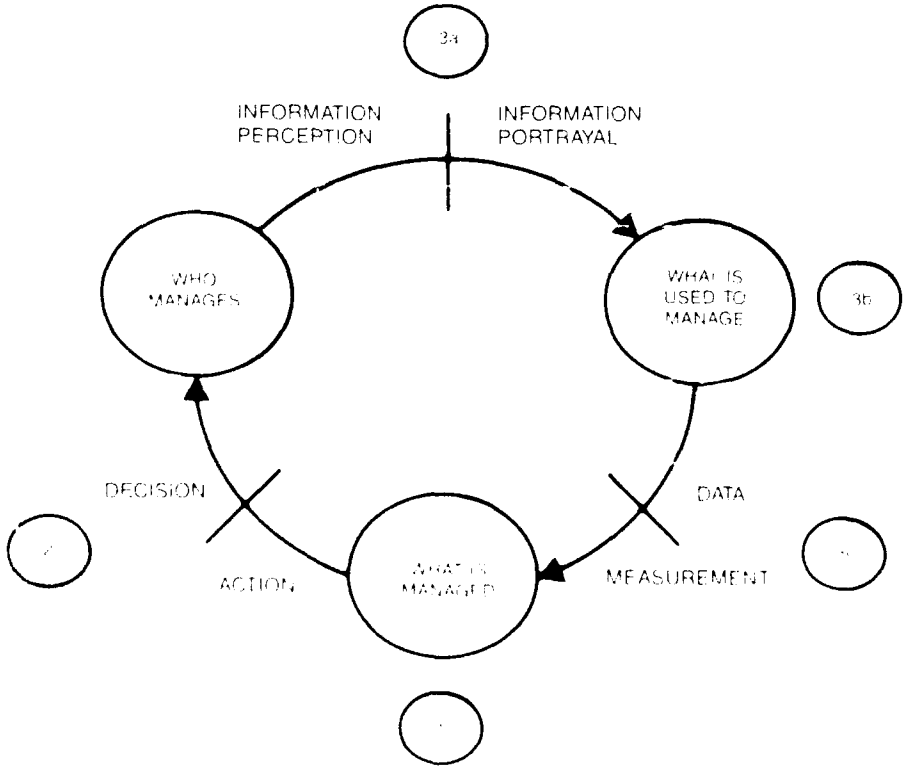
Measurement



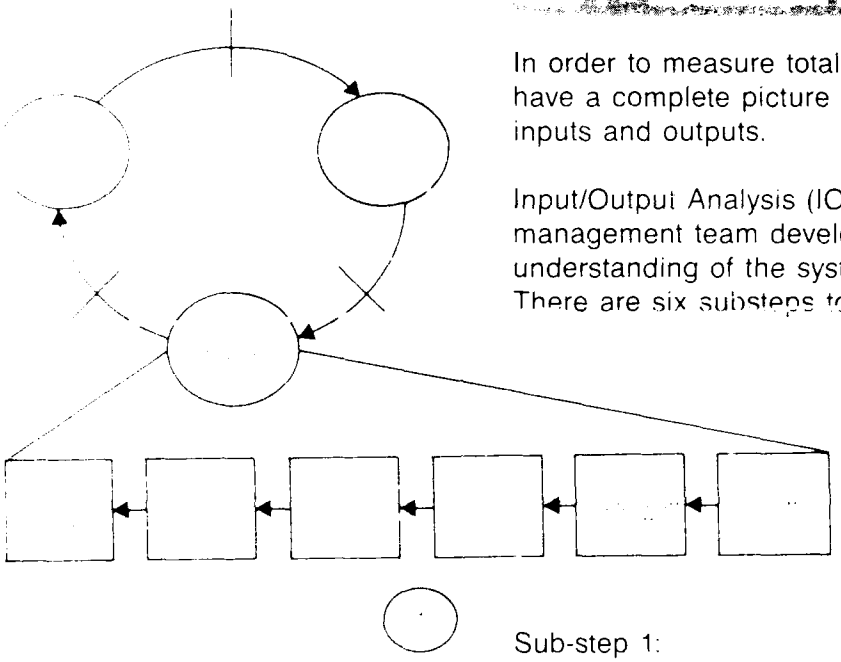
Measures and measurement systems designed and used by managers, management teams, or employees, for the purpose of improvement look different and operate differently than measurement systems designed and used by other audiences for control purposes. Most managers spend 95 percent of the measurement effort on control-oriented systems. The Defense Contractor of the Future will need to attain a better balance between improvement-oriented measurement systems and control-oriented measurement systems.

Follow Management Systems Analysis to Build Better Measurement Systems

Management Systems Analysis (MSA), based on the Management Systems Model, will help you design more effective improvement-oriented measurement systems, regardless of the target system measured. Management Systems Analysis is a five-step process and should be carried out in facilitated small-group sessions, with the management team responsible and accountable for the target system. Using MSA, the measurement system is built in a clockwise process.



Measurement



In order to measure total performance we must have a complete picture of the target system's inputs and outputs.

Input/Output Analysis (IOA) helps the management team develop a better understanding of the system they manage. There are six substeps to IOA:

Sub-step 1:

Outcomes – What are we trying to accomplish? How do we define success?

Sub-step 2:

Downstream systems (i.e., customers, internal or external) are listed. Who are they? What do they want, expect, need, and demand from us? How can we serve them better?

Sub-step 3:

Outputs are listed. It is important to distinguish between outcomes in this step.

Sub-step 4:

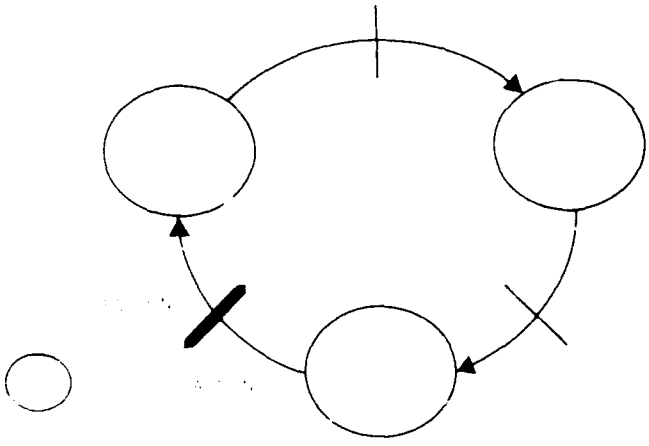
Processes are listed. Identify major activities or transformations made within the system to convert inputs to outputs. The secret to this sub-step is to strike a balance between "micro" and "macro."

Sub-step 5:

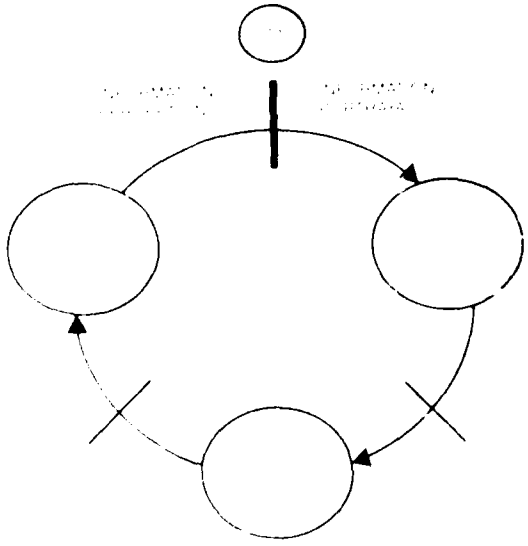
Inputs are listed. Who do they come from? How do we use them? Again, the balance between "micro" and "macro" needs to be preserved. Labor, materials, energy, and capital are too "macro" a list. On the other hand, paper clips, staples, and pads of paper are too "micro."

Sub-step 6:

Upstream systems (i.e., internal and external customers, suppliers, vendors) are listed. Who are they? What do we want, need, demand, and expect from them? How can they serve us better?

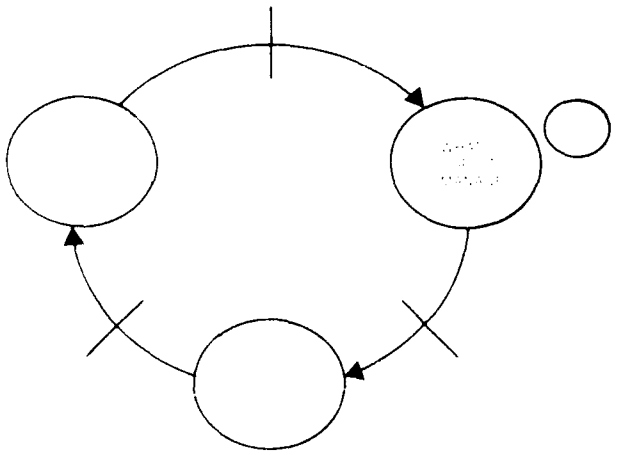


Step 2 is designed to focus the management team on improving performance and coming to a consensus on performance improvement interventions. The Nominal Group Technique is an effective tool for realizing this goal (see Chapter 4).

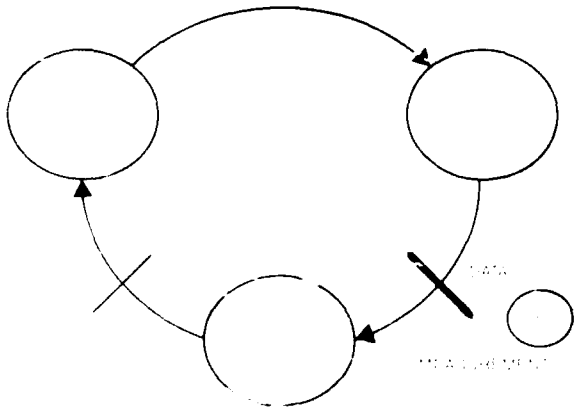


Step 3a focuses on two sets of questions. One set addresses information needed to support decision making: how will we know if we should implement the performance improvement intervention; if we are using the

right amount of resources; and if we are executing the intervention right? The second set of questions addresses the information needed to tell us if the interventions have had a positive impact on performance. The Nominal Group Technique may again be useful for obtaining this data.



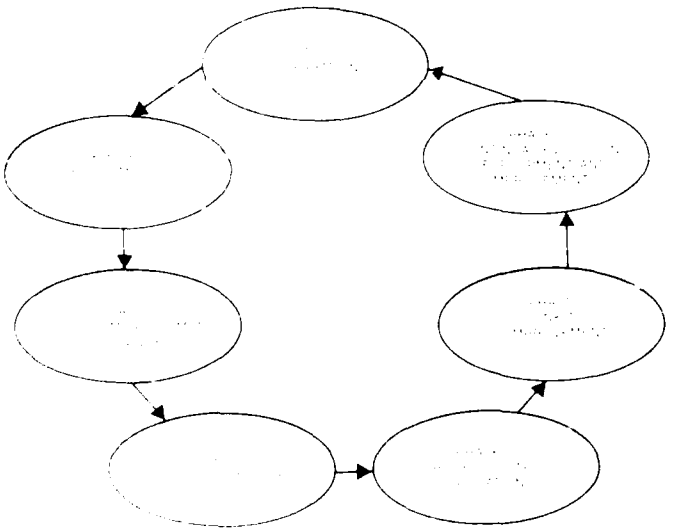
This step in MSA asks: "What tools or techniques are, will be, can be, or should be used to transform data into information?" Examples of specific techniques that might be representative are software packages (i.e., spreadsheet applications, special purpose applications, etc.), charts, forms, procedures, and accounting reports. The decision-maker's judgment, experience, and intuition are also viewed as tools and techniques that are valuable to this step.



The primary questions to be answered are: What data do we require in order to provide the information identified in Step 3a? Where will the data be obtained? How will we obtain/retrieve the data? What data required are not currently available, and how will we obtain them? This step focuses the management team's attention on data sources, data base issues, data acquisition, data retrieval and data requirements.

Proper execution of MSA will result in well designed improvement oriented measurement systems. A general measurement methodology has been designed to guide you through MSA.

Executing MSA: General Measurement Methodology



There is a general measurement methodology for executing MSA (Sink and Tuttle, 1988). This methodology flows out of MSA and drives measurement with a focus on improvement. The methodology is "collarless": that is to say, it's effective for white-collar as well as blue-collar applications. The methodology is also effective for any target system, from the company level to the work group level.

Phase 0: Preparation

0-1 Understand and promote the primary purpose of measurement: to drive improvement.

0-2 Form a Measurement Development Team consisting of persons knowledgeable about the target system, complemented by measurement masters.

0-3 Gain a better understanding of the target system by performing an input/output analysis.

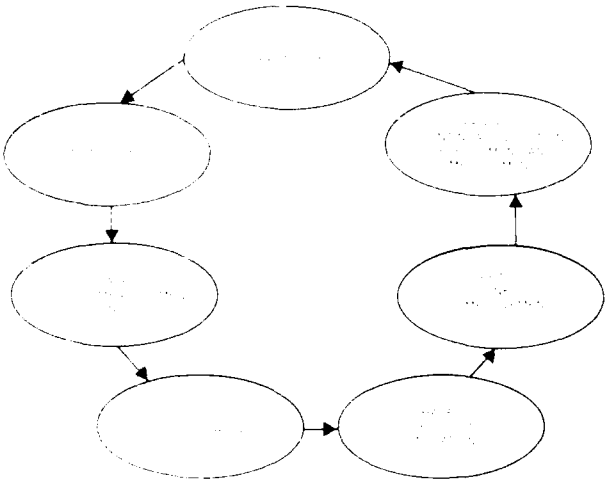
0-4 Review the Strategic Performance Improvement Plan.

Phase I: What to Measure

I-1 Identify performance measures using the NGT.

I-2 Audit the list of measures to improve quality (see next section)

I-3 Break down each measure into "measurable" attributes, subattributes, indicators, surrogates or proxy measures.



Phase II: Develop Measurement Techniques

II-1 Use measurement masters to select the techniques needed to provide the information identified in Phase I.

II-2 Form a Design Team that will be responsible for designing possible applications of the technique.

II-3 Determine whether the techniques selected can be implemented.

II-4 Modify and adapt the techniques to fit your particular application.

Phase III: Collect the Data

III-1 Identify what data are needed to provide the information.

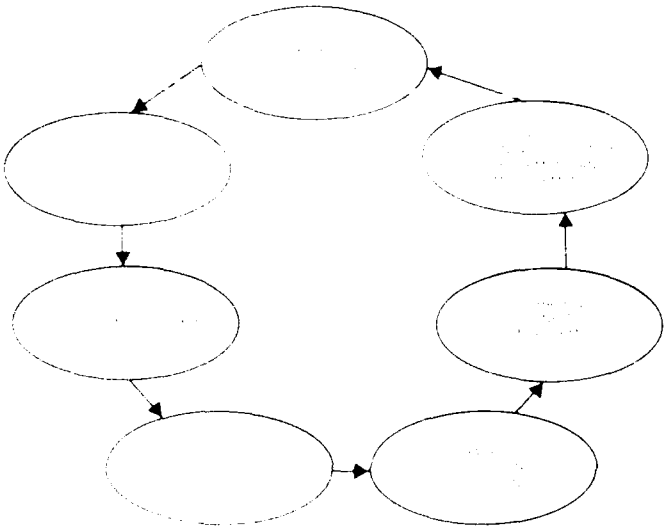
III-2 Identify where the data can be found and how they can be obtained.

III-3 Eliminate measures that are, for one reason or another, impractical. Other measures may be available and might be used. Consult AIM to ensure that eliminating a measure doesn't sacrifice quality and validity.

III-4 Design a process for collecting, storing, and retrieving data.

III-5 Assign accountabilities and responsibilities for keeping each measure up to date.

III-6 Implement the system and begin data collection.



Phase IV: Process Output Validation

IV Address and manage critical questions and concerns that will arise at this point: "Is this all there is? We thought there would be more. This isn't as helpful as we thought. How do we use this information? Is this worth the cost? We don't believe the results – we're not that good; we're not that bad." These difficulties are predictable, understandable, and manageable.

Phase V: Link to Improvement

V The management effort will fail unless this phase occurs. Execution of this methodology helps to ensure the development of the measurement-to-improvement link.

Phase VI: Continual Evolution Development and Improvement

VI The design, development, and effective implementation of measurement systems must be approached with the same discipline and constant improvement orientation applied to improvements in process, product, and service.

For more "how to" on the General Measurement Methodology, see Sink and Tuttle (1988).

During execution of Phase I of the General Measurement Methodology, questions often arise as to the quality of the measures generated. Are we measuring what we said was important? Are the measures comprehensive? An audit of the quality of these measures is the subject of our next section.

Measurement

Auditing Existing Measurement and Evaluation Systems, and Current and Proposed Measures

The audit form following provides you with the information needed to improve measures and measurement systems. Using the audit, your measures and measurement system are evaluated against three factors: planning process output, performance criteria, and organizational system components. The audit form is completed by marking the appropriate cell (with either check marks or "bullets") for each measure or measurement system as it relates to each audit factor.

While filling out the table, consider what each item is intended to measure, rather than the strategies involved in improving performance in each measure.

This first audit factor indicates whether measurement supports the plan (i.e., vision, long-range goals, objectives). This is essential to ensure that the desired outcomes are achieved. Avoid falling into the trap of measuring A while hoping for B.

The next audit factor identifies specific performance criteria which may have been overlooked or improperly addressed by existing measures or measurement systems. Measures for all seven performance criteria may or may not be needed.

The third audit factor classifies each measure as a measure of input variables, transformation processes, output variables, or outcomes. Quite often, we find that most of our measures are "inside the box," focusing on processes and ignoring inputs, outputs, and outcomes.

Once the audit is complete, you can evaluate the quality of your measurement system design and determine what changes are needed, such as adding missing measures, or removing repetitive unnecessary measures.

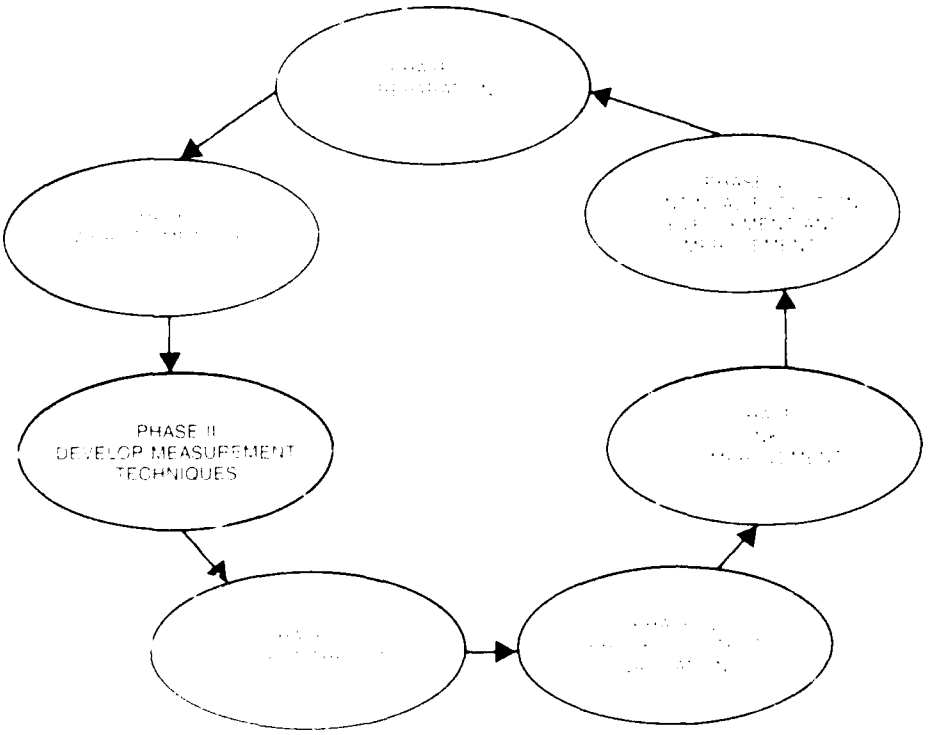
Auditing to Improve Measures (AIM)

MEASURES / AUDIT FACTOR	1. PRODUCTION COSTS	2. PERCENT OF SCHEDULES MET	3. MANAGE TO PAYROLL	4. QUALITY REJECT LEVELS	5. RESPONSIVENESS	6. NO. OF DEFICIENCIES NOTED	7. DOLLARS RECEIVED VERSUS WORKLOAD PLANNED	8. NO. OF DEFECTIVE PRODUCT COMPLAINTS	9. NO. OF EXPLOSIVE INCIDENTS	10. NO. OF NEW PRODUCT STARTS	11. EMPLOYEE ATTRITION	12. DIRECT/INDIRECT RATIO (BOTH DOLLARS AND PEOPLE)
PLANNING PROCESS*												
International Recognition								•		•		
Employee Safety						•			•		•	
Resource Allocation	•		•				•					
Constant Improvement												
Mobility												
Quality of Work Life												
Role Model												
Responsiveness					•							
PERFORMANCE CRITERIA												
Effectiveness	•	•			•							
Efficiency	•		•									•
Quality		Q_4		Q_4	Q_5	Q_3		Q_5	Q_3			
Productivity												
Quality of Work Life											•	
Innovation			•						•	•		
Profitability/Budgetability	•		•				•					
ORIGINAL SYSTEM												
INPUT Labor	•		•									
Material	•											
Capital												
Energy												
Data/Information												
PROCESSES			•						•			
OUTPUTS		•		•					•			
OUTCOMES					•		•					

*[illegible] CORPORATE LONG RANGE OBJECTIVES (STRATEGIC PERFORMANCE DIMENSIONS OR KEY RESULT AREAS) ARE SHOWN HERE

Measurement

In the next section, we review some of the newer measurement techniques you need to be familiar with in order to build measurement systems for the Defense Contractor of the Future.



Measurement Techniques: How to Measure

Conventional measurement techniques have served us well for the better part of the last century. There is, however, a "revolution" beginning to take place in measurement techniques that is being driven by changing environments (internal and external), changing technology, evolving disciplines, and innovative managers, academicians, and consultants. Several of the newer measurement techniques, and the ones that will be discussed here, are shown below. While this is not a complete list, it does represent the major techniques now being used by innovative companies and which are most applicable to A&D companies.

These new measurement techniques must be learned, experimented with, and integrated into your management systems.

CONVENTIONAL TECHNIQUES

[illegible]

NEWER TECHNIQUES

THE TOTAL FACTOR PRODUCTIVITY MEASUREMENT MODEL (TFPMM)

THE MULTI-CRITERIA PERFORMANCE MEASUREMENT TECHNIQUE (MCPMT)

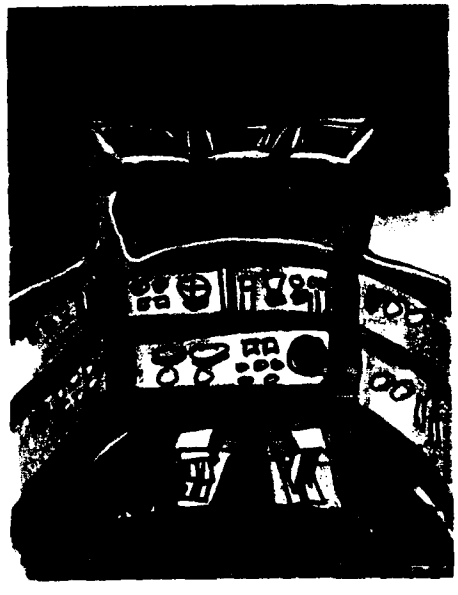
STATISTICAL PERFORMANCE CONTROL (SPERC)

COST DEFINITION METHODOLOGY (CDEF) - COST BENEFIT ANALYSIS AND TRACKING

[illegible]

Measurement

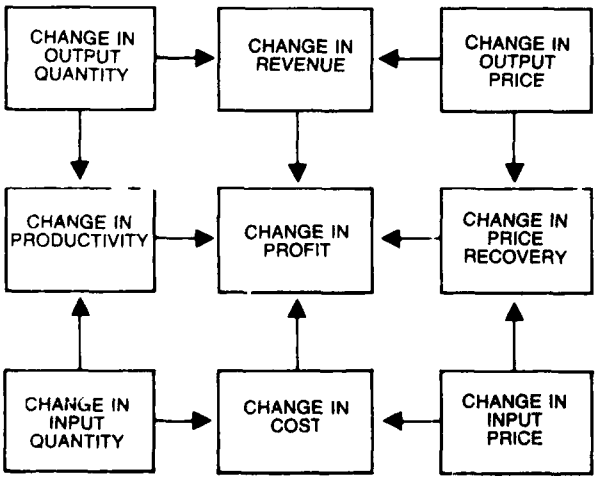
The designers and engineers who were part of the evolution of aircraft control panels fully appreciate the challenge in measurement design faced by managers in the coming decades. Try to imagine the evolutionary process in instrumentation that took place from the design of the Wright Brother's first airplane to that of the Boeing 757. It was a slow, painful, costly, uncertain, and often risky process. We have the opportunity and challenge of developing "instrument panels" for the Defense Contractor of the Future.



Total Factor Productivity Measurement Model: A Technique for Measuring Productivity

Conventional approaches to productivity measurement calculate and portray productivity changes as numerical ratios and indexes. The Total Factor Productivity Measurement Model calculates and translates these numerical ratios and indexes into financial terms (i.e., the dollar effects on profits due to changes in productivity and price recovery). The TFPMM provides insights into where improvement leverage exists and ties productivity measurement to the "bottom line."

CONCEPTUAL FRAMEWORK FOR THE TFPMM



SOURCE: VAN LOGGERENBERG AND CUCCHIARO, 1982)

The TFPMM can and is being used to:

- Obtain an overall, integrated measure of plant and firm level productivity
- Measure how, in dollars, profits were affected by productivity growth or decline
- Evaluate company profit plans
- Plan, develop, and control budgets
- Track the results of specific productivity improvement interventions
- Assist in setting productivity objectives
- Measure how the firm's or plant's productivity performance is strengthening or weakening its overall competitive position

The TFPMM is most appropriate at the firm and plant levels. The figures on this and the following page depict a case study example. The figure represents the computer output or tableau for the TFPMM. Only a portion of the output is presented here, but it will suffice as an example by which to illustrate the model.

Columns 1-6 are data input to the model. The data required for the TFPMM are periodic (i.e., monthly, quarterly, annually, or annually updated quarterly) data for quantity, price, and value of each output and input of the system being analyzed. Price inflators or deflators can be used as surrogates for actual prices.

	BASE PERIOD DATA			CURRENT PERIOD DATA		
	QUANTITY (1)	PRICE (2)	VALUE (3)	QUANTITY (4)	PRICE (5)	VALUE (6)
WEAPON SYSTEM A	10	50000	500000	12	50500	606000
WEAPON SYSTEM B	5	75000	375000	8	77500	620000
TOTAL OUTPUTS			375000			1226000
DIRECT SALARY & WAGES	30000	8	240000	31500	9	283500
INDIRECT SALARY & WAGES	9000	12	108000	8750	12.50	109375
TOTAL LABOR			348000			392875
DIRECT MATERIALS	4500	50	225000	5700	85	484500
SUPPLIES & INDIRECT	1250	5	6250	1550	5	7750
TOTAL MATERIALS			231250			492250
ELECTRICITY (1000 kwh)	600	40	24000	675	45	30375
NATURAL GAS (100 ccl)	450	4	1800	500	4	2000
TOTAL ENERGY			25800			32375
LEASE COSTS	106500	0.15	15975	110250	0.15	16537.50
EQUIP. DEPRECIATION	98500	0.12	11820	97200	0.12	11664
TOTAL CAPITAL			27795			28201.50
TOTAL INPUTS			632845			945701.50

	WEIGHTED CHANGE RATIOS		
	QUANTITY (7)	PRICE (8)	VALUE (9)
WEAPON SYSTEM A	1.20	1.01	1.21
WEAPON SYSTEM B	1.60	1.03	1.03
TOTAL OUTPUTS	1.37	1.02	1.02
DIRECT SALARY & WAGES	1.05	1.13	1.18
INDIRECT SALARY & WAGES	0.97	1.04	1.01
TOTAL LABOR	1.03	1.10	1.13
DIRECT MATERIALS	1.27	1.70	2.15
SUPPLIES & INDIRECT	1.24	1.00	1.24
TOTAL MATERIALS	1.27	1.68	2.13
ELECTRICITY (1000 kwh)	1.13	1.13	1.27
NATURAL GAS (100 ccf)	1.11	1.00	1.11
TOTAL ENERGY	1.12	1.12	1.25
LEASE COSTS	1.04	1.00	1.04
EQUIP. DEPRECIATION	0.99	1.00	0.99
TOTAL CAPITAL	1.01	1.00	1.01
TOTAL INPUTS	1.12	1.31	1.46

Columns 7-9 depict the percentage of increase (or decrease) on an output or input from the base to current period.

Columns 10 and 11 depict cost/revenue ratios. This information provides the user with insights as to where leverage exists.

Columns 12 and 13 are the productivity ratios for the base and current periods, respectively. These numbers will have meaning only once they are tracked over time and interpreted in the context of what is happening or what has happened to the company.

Columns 14-16 represent the weighted performance indexes; these show the percent change in productivity, price recovery, and profitability.

	COST/REV RATIOS		PROD RATIOS		WEIGHTED PERF INDEXES		
	BASE (10)	CURRENT (11)	BASE (12)	CURRENT (13)	PROD (14)	PRICE (15)	PROFIT (16)
WEAPON SYSTEM A							
WEAPON SYSTEM B							
TOTAL OUTPUTS							
DIRECT SALARY & WAGES	0.2743	0.2312	3.65	4.76	1.31	0.91	1.18
INDIRECT SALARY & WAGES	0.1234	0.0892	8.10	11.43	1.41	0.98	1.38
TOTAL LABOR	0.3977	0.3205	2.51	3.36	1.34	0.93	1.24
DIRECT MATERIALS	0.2571	0.3952	3.89	4.21	1.08	0.60	0.65
SUPPLIES & INDIRECT	0.0071	0.0063	140.00	154.84	1.11	1.02	1.13
TOTAL MATERIALS	0.2643	0.4015	3.78	4.10	1.08	0.61	0.66
ELECTRICITY (1000 kwh)	0.0274	0.0248	36.46	44.44	1.22	0.91	1.11
NATURAL GAS (100 ccf)	0.0021	0.0016	486.11	600.00	1.23	1.02	1.26
TOTAL ENERGY	0.0295	0.0264	33.91	41.38	1.22	0.91	1.11
LEASE COSTS	0.0183	0.0135	54.77	72.56	1.32	1.02	1.35
EQUIP. DEPRECIATION	0.0135	0.0095	74.03	102.89	1.39	1.02	1.42
TOTAL CAPITAL	0.0318	0.0230	31.48	42.55	1.35	1.02	1.38
TOTAL INPUTS	0.7233	0.7714	1.38	1.70	1.23	0.78	0.96

Columns 17-20 indicate what impact, in dollars, was caused by changes in productivity, price recovery, the joint effects of productivity and price recovery, and profitability. We can use this information to identify areas in need of improvement and to identify areas that are operating at acceptable levels. We see the bottom line in this Aerospace and Defense contractor became $39,526.36 less profitable from the base to the current period. This case application discussion should suffice to clarify the basic characteristics of this technique for measuring productivity and other elements of performance. Software support is available from the National Productivity Institute of South Africa (REALST) and the VPC at Virginia Tech (SCORBORD).

	DOLLAR EFFECT			
	PROD (17)	PRICE (18)	JOINT (19)	PROFIT (20)
WEAPON SYSTEM A WEAPON SYSTEM B TOTAL OUTPUTS				
DIRECT SALARY & WAGES	77142.86	-25200.00	282.86	52225.71
INDIRECT SALARY & WAGES	43114.29	-2340.00	927.29	41701.57
TOTAL LABOR	120257.14	-27540.00	1692.90	94410.04
DIRECT MATERIALS	23571.43	-153000.00	-40328.57	-169757.14
SUPPLIES & INDIRECT	821.43	125.00	46.43	992.86
TOTAL MATERIALS	24392.86	-152875.00	-40168.63	-168650.77
ELECTRICITY (1000 kwh)	5914.29	-2520.00	-196.71	3197.57
NATURAL GAS (100 ccf)	468.57	36.00	13.37	517.94
TOTAL ENERGY	6382.86	-2484.00	-180.44	3718.42
LEASE COSTS	5371.07	319.50	118.67	5809.24
EQUIP. DEPRECIATION	4546.29	236.40	87.81	4870.49
TOTAL CAPITAL	9917.36	555.90	206.48	10679.73
TOTAL INPUTS	160950.21	-182343.10	-18133.47	-39526.36

The Multi-Criteria Performance Measurement Technique: A Technique for Measuring Performance

An organizational system needs multiple measures in order to assess and evaluate performance. Making sense out of these various measures to determine overall performance is a frustrating and difficult task. The Multi-Criteria Performance Measurement Technique helps to simplify this task and is useful for understanding how diverse performance measures serve as indicators of performance. It is especially useful measuring the performance of hard to measure target systems, such as professional, technical, office, and clerical work groups.

The technique is used to combine various performance measures to get an overall picture of performance. In other words, the technique can be used to portray performance using one indicator (i.e., the overall performance index for the system) or as one indicator for overall performance and one for each measure.

Rate and Weight the Measures

An output of Phase I of the General Measurement Methodology is a consensual prioritized list of information needs or measurement criteria. Assign 100 points to the top priority measure. Next, assess the relative importance of the second most important measure relative to the top priority measure. This paired comparison relative assignment of points is done for each successive measure (i.e., the importance of each measure is compared to the importance of the one immediately above in ranking). The individual points assigned to each are summed to arrive at the total points assigned for all measures. Relative weights are then determined by dividing the individual points assigned to a measure by the total points.

MEASURE	RANK	RATE	WEIGHT
PROJECTS COMPLETED AND ACCEPTED IN CONSTANT VALUE BUDGET DOLLARS	1	100	0 137
CUSTOMER SATISFACTION	2	100	0 137
QUALITY OF DECISION SUPPORT FROM PRESENT SYSTEMS	3	100	0 137
MEETING USER FLEXIBITY REQUIREMENTS	4	90	0 123
USE OF PROJECT MANAGEMENT AND SCHEDULING TECHNIQUES	5	90	0 123
PROJECTS COMPLETED ON TIME/TOTAL # OF PROJECTS	6	85	0 116
NUMBER OF REQUESTS FOR REWORKING OR REDOING A PROJECT	7	85	0 116
QUALITY OF STRATEGIC PLANNING	8	80	0 101
TOTAL		730	1 000

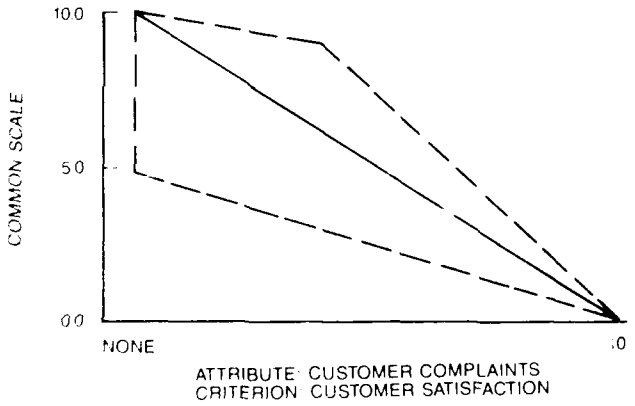
When this step is complete, you have a sense of the relative importance of each criterion to overall performance. The rating and weighting process can be performed unilaterally by the manager of the group, by measurement masters, or participatively by the measurement development team who identified the criteria and rankings.

Select a Common Performance Scale

A common performance scale needs to be selected that converts the diverse measures into some common denominator. The performance scale typically chosen is a 0 to 10.0 scale, where level 0 represents the lowest level of performance possible for a given measure. Level 5 represents an acceptable performance level. Level 10 represents the perception of best performance or excellence.

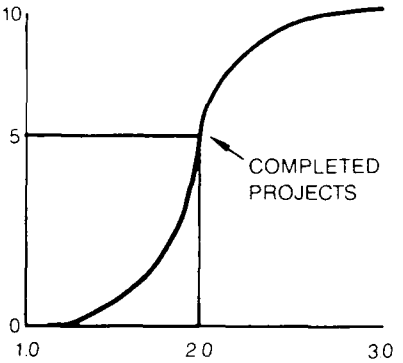
Develop Preference Curves

Each performance measure has at least one "natural" scale with which it can be measured. The objective of this step is to develop a valid set of natural scales for each measure and to match levels of performance on the natural scale to levels of performance on the common scale. The natural scales are designed so that one end corresponds to a 0 (worst performance), and the other end to a 10 (best performance); a 5 is "acceptable performance." A preference curve, which can and often will be subjective, is developed for each measure and is used to transform performance on the natural scale to a common scale through a performance function graph.

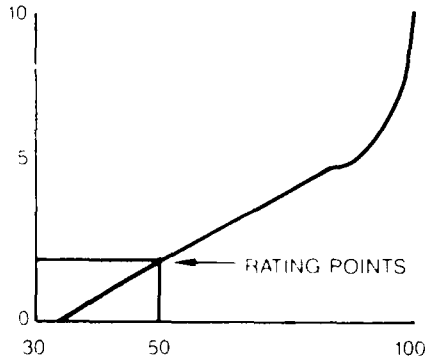


Determine Overall Performance

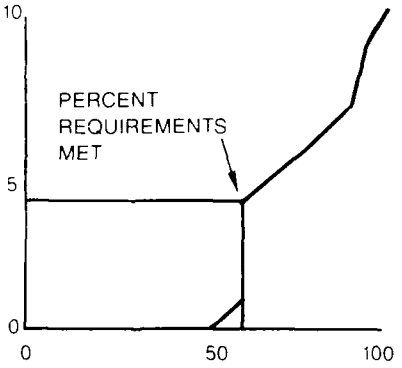
The figure to the right depicts a transformation of current performance data to a common scale. You will want to plot the score for overall performance and each criterion and track them over time. For the "Projects Completed" example, actual performance for projects completed and accepted was 2. Using the preference curve, this 2 translates to a 5, indicating acceptable performance for this period.



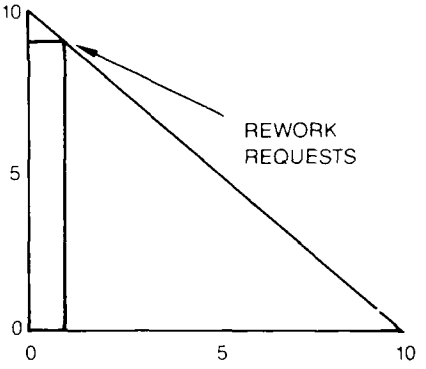
PROJECTS COMPLETED
WEIGHT 0.137
RESULT 2.0
SCORE 6
WEIGHTED SCORE 0.822



QUARTERLY OF DECISION SUPPORT
WEIGHT 0.137
RESULT 50
SCORE 2
WEIGHTED SCORE 0.274



MEETING USER FLEXIBILITY
REQUIREMENTS
WEIGHT 0.123
RESULT 0.6
SCORE 4
WEIGHTED SCORE 0.492



NUMBER OF
REWORK REQUESTS
WEIGHT 0.116
RESULT 1
SCORE 9
WEIGHTED SCORE 1.044

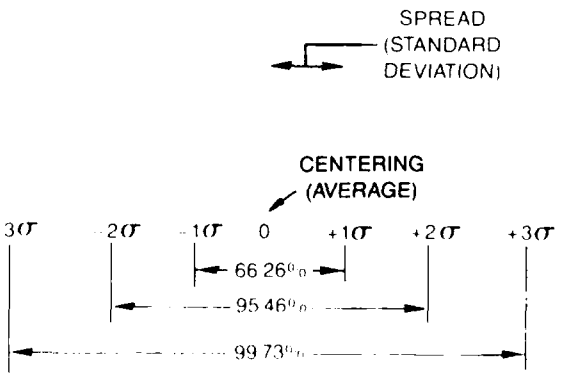
Software support is available from the Oregon Productivity Center (OMAX) and the VPC (PRFORM).

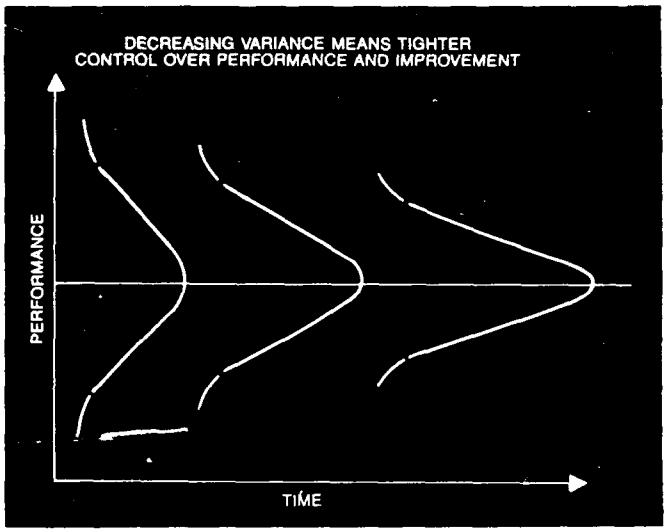
Measurement

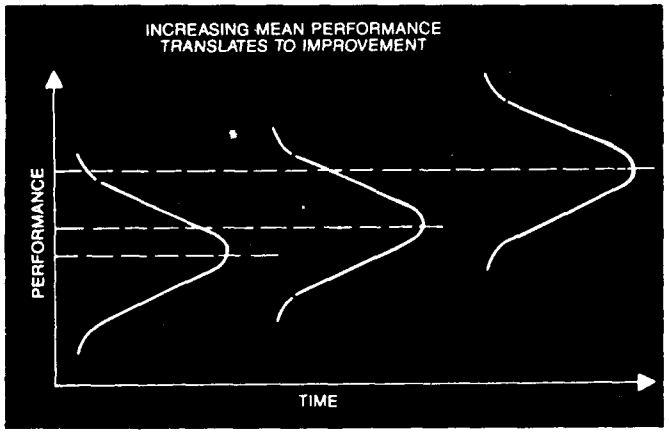
Statistical Performance Control: A Technique for Portraying System Performance

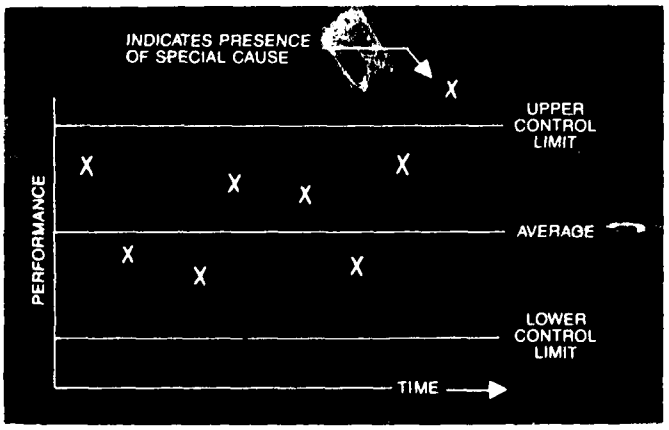
Statistical Performance Control (SPerfC) is a technique that helps a management team understand variations in performance. It applies the basic principles of Statistical Process Control to the broader issue of performance. Using SPerfC we can determine whether performance of the target system is "in-control" or "out-of-control." This information is useful in determining what type of intervention is needed to improve performance.

Performance is always subject to a certain amount of variation – we should all expect it and not be surprised when it occurs. There is information in variation, and statistics can be used to describe these patterns of variation. Descriptors used include: measures of the central tendency of a distribution (i.e., mean or average) combined with some measure of dispersion of the distribution (i.e., variance and standard deviation). Below is an example of a distribution many of us are familiar with, the normal distribution:









SPerfC detects changes in performance variation and mean performance levels using a control chart. The control chart has a center line that represents actual average performance and two control limits, upper and lower. A control limit indicates a theoretical boundary for the normal variation due to common (normal) causes. Performance falling outside the control limits indicates the presence of a special (assignable) cause. A common cause is one which is inherent in the design of the system and cannot be changed or removed by those who are a part of the system; common causes must be tackled by those who manage or design the system. A special cause is an assignable cause of variation due to certain events occurring within the system and can be removed by those in the system. In a state of statistical control, all special causes of variation have been removed. The remaining variation must be left to chance – that is, to common causes – unless a new special cause turns up. Improvement of the process can be pushed effectively once statistical control is achieved. Removal of a special cause does not improve the system; it only brings the system back to where it should have been in the first place. To achieve performance improvement, both types of causes must be analyzed (for more on common and special causes, see Deming 1986). The SPerfC provides you with this information on all seven performance criteria (effectiveness, efficiency, quality, productivity, quality of work life, innovation, and profitability/budgetability).

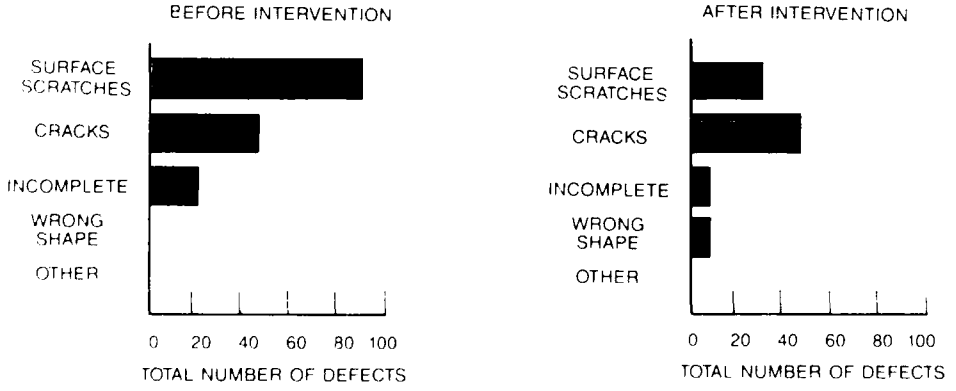
Once performance is "in control," which is not a natural state but an achievement, management is ready to act on the system to improve performance. Managers can improve the system by decreasing the amount of variation or by shifting the mean.

Other Statistical Techniques

The control chart used in SPerfC is not the only statistical tool for measuring performance. There are five other tools and techniques, all of which can be used by everyone from the president on down to measure and improve performance. Most all performance problems can be solved using these tools.

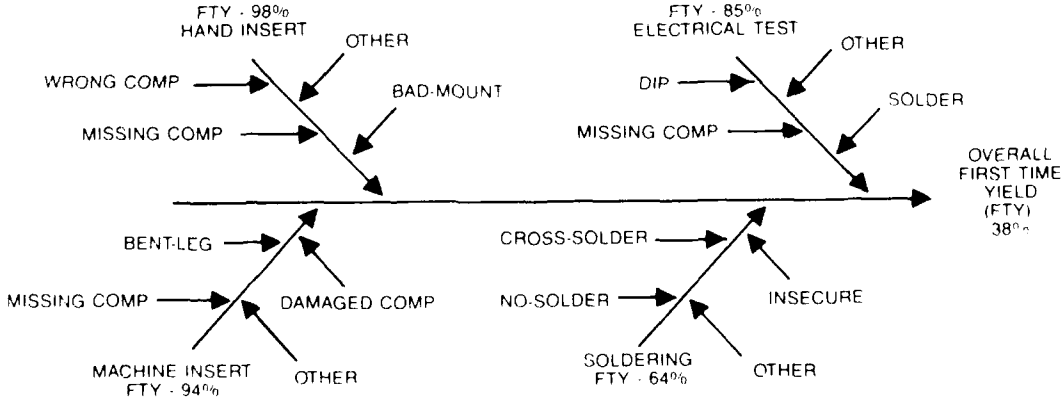
1) *Pareto Chart*. The Pareto Principle, the principle of the "vital few, trivial many," was espoused by Juran (1964). The Pareto Chart is simply a way of rank ordering the causes of problems.

SAMPLE PARETO CHART
(SOURCE: WADSWORTH, STEPHENS, AND GODFREY, 1986)



2) *Cause and Effect Diagram.* The cause-and-effect diagram is sometimes called a Fishbone plot (because of its shape) or an Ishikawa diagram (see Ishikawa 1970). By any name it is an extremely effective graphical method for dispersion analysis, process clarification, and cause enumeration. In the example below, circuit pack yield has been identified as a target for a troublesome manufacturing process. From the middle baseline pointing to the yield figure, main spines are constructed for each major cause of yield problems. Although this is a simple example, we can very easily see where the problems are and where efforts should be focused.

SIMPLE CAUSE AND EFFECT DIAGRAM FOR CIRCUIT PACK ASSEMBLY PROCESS



(SOURCE: WADSWORTH, STEPHENS, AND GODFREY, 1986)

3) *Checksheets.* One of the simplest yet most effective graphical methods is the checksheet. It is an easy way to collect and analyze data and present results. Tally sheets, location plots, clustering by type, and traveling checksheets are different types of checksheets.

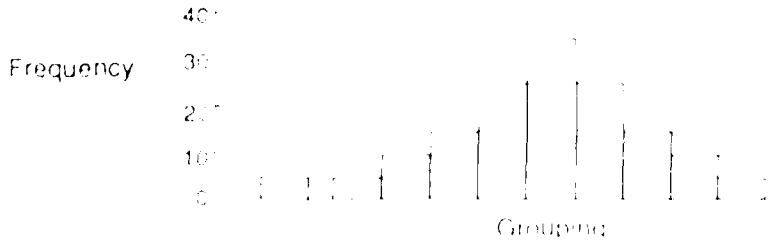
SAMPLE CHECKSHEETS
[illegible] WADSWORTH STEPHENS AND GODFREY 1986

A TALLYSHEET

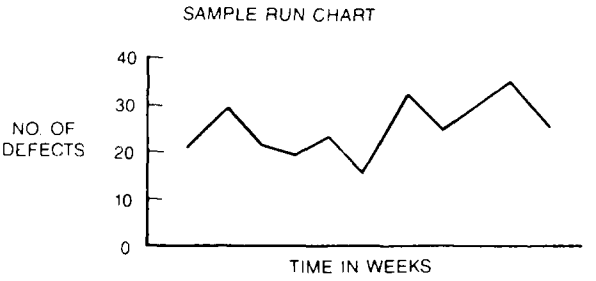
TYPE	# OF NONCONFORMITES	
FUNCTIONAL TEST	//// //// //	12
SOLDERING	//// //// //// //// //// ////	30
PLATING	///	3
OTHERS	//// ///	8
TOTAL		53

4) *Histograms.* A histogram is a very direct way of showing frequencies of occurrences or counts. From a histogram, we can quickly determine the distribution of data and see its variation.

Sample Histogram



5) *Scatterplots*. Scatterplots, sometimes called x-y plots or crossplots, are easy and effective. Plot bivariate data (x, y) by constructing a scale on the x-axis that covers the range of x values and a scale on the y-axis that covers the range of y values. Scatterplots can be simple dot plots, where each bivariate pair is represented by a point, or the points can be connected as in a time series or replaced by numbers and symbols. Scatterplots are a first step in many quality investigations or data analyses. Run charts are one type of scatterplot.



We have presented some simple graphical methods that have widespread applicability for an A&D Contractor. Every employee, from the president on down, should have at least a basic understanding of each method. Intermediate statistical techniques, such as theories of sampling surveys, statistical sampling inspection, methods of making statistical estimates and tests, and design of experiments, should be taught to engineers. Advanced statistical methods, such as advanced experiment design, Taguchi Methods, multivariate analysis, and operations research will be required by a very limited number of engineers and technicians

Measurement

The application of CDEF/FMP for a particular organization is primarily dependent on the complexity of the operational activities within the unit of analysis (facility, work center, work cell). As long as the unit of analysis can be "bounded" in terms of resources utilized (labor, equipment, facilities, utilities, etc.) and in financial terms, there is practically no limit to the diversity of organizations that can apply CDEF/FMP. The resource utilization data required are within any organization where financial statements are compiled. Quality, responsiveness, and capacity data may be more difficult to obtain.

CDEF/FMP responds to the necessary, but demanding, tasks of both improvement and modernization planning. The current nature of most manufacturing environments places many constraints on the adequacy of traditional information systems and analytical techniques to quantify and qualify improvement projects and to track benefits. Some of the more common constraints include: shortening of product life cycles, increasing quantities of engineering changes, production processes less reliant on direct labor, and improved production processes which rarely replace existing processes on a one for one basis.

The figure to the right depicts an overview of the CDEF/FMP methodology. The steps are detailed in the following paragraphs. For the purposes of this description, the emphasis has been placed on Phase I (Needs Analysis and Development of Improvement/Modernization Plan). The full scope of CDEF/FMP includes Detailed Design (when required) and implementation.

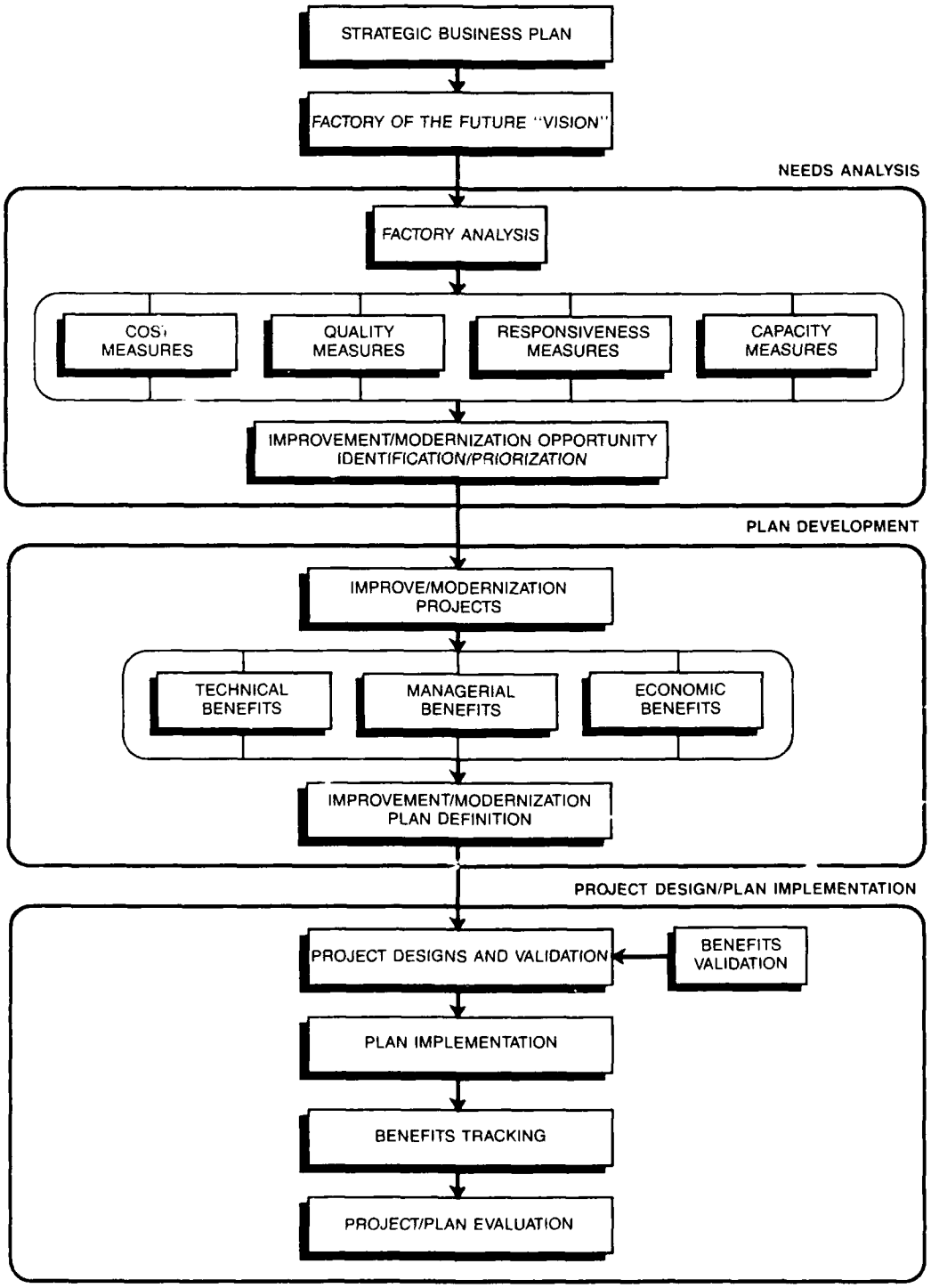
Several elements are crucial to successfully utilizing CDEF/FMP:

- The constant and active involvement of upper and middle management.
- The use of multi-disciplined project teams.
- The on-going management commitment to allocate the resources necessary to implement the resultant Facility Improvement/Modernization Plan.

Organizations which successfully utilize CDEF/FMP can expect the following benefits:

- A cohesive, prioritized facility-wide improvement/modernization plan.
- A project team which is intimately familiar with the competitive strengths and shortcomings of the facility.
- Increased recognition of significant product cost containment and reduction opportunities.
- Effective monitoring of the costs and benefits of improvement programs.
- Improvement programs which focus on the Critical Success Factors of the facility and true performance drivers of each operational function.
- Improved visibility and control of costs, quality, responsiveness, and capacity.

Measurement



Phase IA – Needs Analysis

Step 1 – Program Management. The tasks included in this step are: (1) "tuning" the work plan to the specific environment of the facility, (2) assembling the project team and management steering committee, and (3) continually monitoring execution of the work plan throughout the project to assure that schedules are maintained and anomalies resolved. The product from this step is a well-planned, well-controlled improvement planning project.

Step 2 – Education and Training. The tasks included in this step are: (1) management education and (2) project team training. Management education is usually a half day on the CDEF/FMP methodology, its approach to improvement opportunity identification and justification, and the intended "products" of the improvement planning project. Project team training introduces participants to specific techniques for preparing the functional decomposition of the facility, the cost baseline, the productivity baselines (quality and responsiveness), and the resource utilization profile.

Step 3 – Document Business Strategy. It is not the purpose of a CDEF/FMP project to develop a business strategy for a facility. However, CDEF/FMP does develop a Facility Improvement/Modernization Plan which is directly keyed to the overall business strategy. Thus, it is necessary to fully understand the business strategy before continuing with a CDEF/FMP project. The tasks included within this step are (1) confirmation of the facility's industry, markets, and products, and (2) identification of the facility's business policies (Critical Success Factors, return on investment goals, market share).

Step 4 – Define Current (As Is) Environment. The tasks included in this step are: (1) determine the functional structure of the facility; (2) develop a resource profile for the facility and each function identified; (3) define the flow of product through the facility, and (4) determine how performance (costs, quality, responsiveness, capacity) should be measured. At the completion of this work step, sufficient data should be gathered in order to be able to completely understand, analyze, and portray the As Is environment of the facility.

Step 5 – Analyze the As Is Environment. The tasks included within this step are: (1) establishment of the facility's performance drivers; (2) development of facility performance baselines; (3) extension of the baselines (based on projected volume and mix) for the period of analysis (usually five, often ten, years); and (4) determination of specific improvement opportunities. The completion of this step describes the entire As Is environment of the facility and identifies "where" (but not yet "how") the greatest benefit will be attained from efficiency improvements and/or technology modernization.

Step 6 – Management Briefing. There is one task to this work step – hold a formal briefing with the steering committee, describing the results of the Needs Analysis process. This briefing should provide an overview of: (1) As Is environment; (2) improvement opportunities identified; and (3) recommendations for improvement projects to be further conceptualized. All recommendations for improvement projects should be related to the facility's business strategy; an improvement which does not further the strategy should be rejected.

Phase 1B – Development of Improvement/ Modernization Plan

Step 1 – Prepare Conceptual (To Be) Designs. The tasks included in this step are: (1) considering alternative efficiency enhancement techniques (i.e., Just-In-Time) and/or processing technologies which could improve the performance of a function; (2) selecting an improvement project (usually one for each function with significant improvement potential); (3) determining the resource changes which will result from the improvement; (4) determining work-flow changes; (5) preparing revised and extended performance baselines; and (6) preparing a preliminary justification analysis (including implementation costs and timing). The output of this task is one or more improvement project descriptions. However, each project, at this point, is individually developed without regard to its impact on other parts of the facility.

Step 2 – Develop Facility Improvement/ Modernization Plan. The tasks included in this step are: (1) determine an implementation sequence for the previously conceptualized improvement projects; (2) determine cross-functional (facility-wide) interfaces; (3) determine facility-wide benefits (in addition to the previously developed functional benefits); (4) develop an overall benefits tracking plan; and (5) determine a sequenced implementation plan, including required internal/external resources (personnel, physical, and financial) necessary to complete the plan. The output of this task is the complete Facility *Improvement/Modernization* Plan, *sequenced* according to needs and benefits, interfaced on a facility-wide basis and integrated with the business strategy.

Step 3 – Management Briefing. There is one task to this work step: hold a formal briefing with the steering committee describing the results of the Improvement/Modernization Planning process. This briefing should provide an overview of: (1) the Facility Improvement/ Modernization Plan, (2) the suggested improvement projects, and (3) the anticipated implementation timing, costs, and benefits. At the completion of this step, management should be prepared to make a firm Go/No-Go decision on each improvement project and the overall Facility Improvement/Modernization Plan.

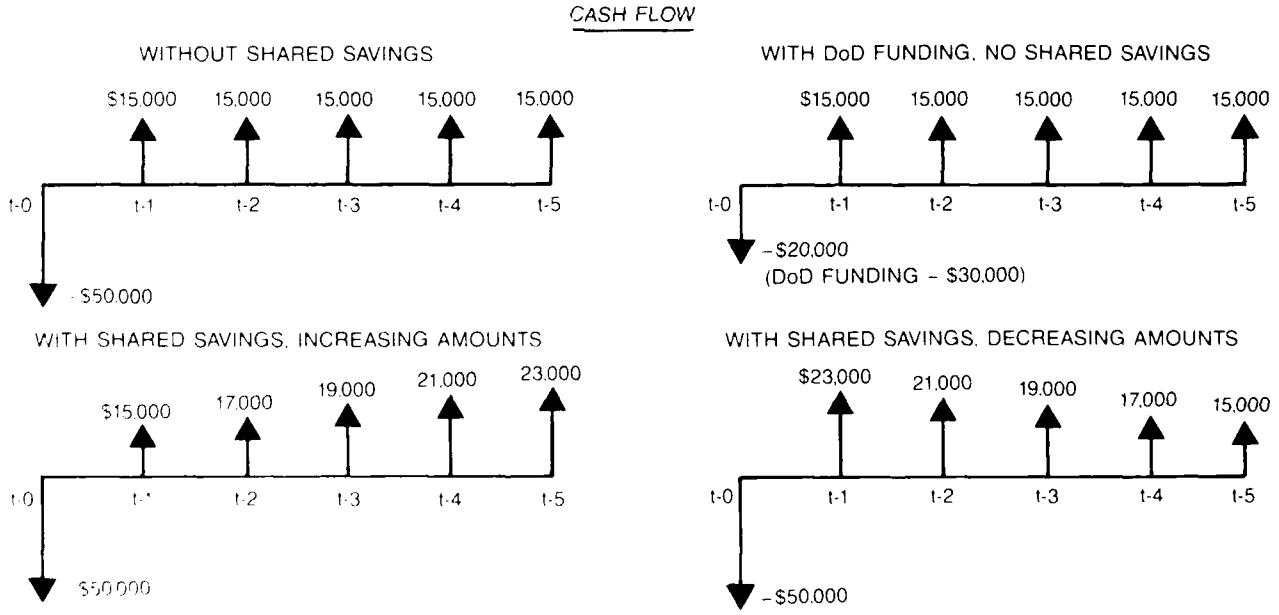
Phase II – Detailed Designs and Phase III – Implementation

For those improvement and modernization projects which do not involve "off the shelf" (available) techniques or hardware and software, it may be necessary to do further design detailing on how the improvement project is intended to function. This task could include the preparation of requirements specifications, issuance of an RFP, evaluation of vendor responses, prototyping, and reconfirmation of the benefits analysis. For those improvement projects which do involve available techniques or hardware and software, it is often possible to proceed directly to implementation. Implementation includes user-training programs, installation of the hardware/software or technique, development of physical and systems controls, possible organizational changes, possible physical relocations, and monitoring of the benefits achieved.

The CDEF/FMP methodology continually stresses the importance of a facility-wide improvement/modernization plan. It is important to keep in mind during implementation that improvement and modernization projects are selected to make the facility as a whole perform better, not necessarily to make individual functions perform at the peak of their unique capabilities.

Discounted Cash Flow/Shared Savings Approach: A Tool for Measuring Economic Feasibility

The Discounted Cash Flow/Shared Saving Approach (DCF/SSA) is used in evaluations and negotiating cost sharing and benefit sharing between the government and contractor in Industrial Modernization Incentive Program initiatives. The DCF/SSA uses cost-benefit data to determine the amount and timing of government and contractor financial investment and the amount and timing of benefits accruing to the government and contractor as a result of that investment.



Measurement

Using the discount rate, cash flows can be converted to a single-value, equivalent "measure of economic effectiveness" in order to assess and evaluate a project's economic feasibility or to assess and evaluate alternative investment projects. A variety of "measures" may be used to express this equivalence: present worth, future worth, annual worth, cost-benefit ratio, and internal rate of return (also called return on investment or the discount rate when present value equals zero). For the DCF/SSA model, the two measures of concern are present worth and internal rate of return.

The DCF/SSA model is primarily applicable at the project level to:

- Evaluate a project's or an alternative project's economic feasibility
- Negotiate the amount of government-to-contractor financial incentives
- Audit actual return on investment after project implementation.

Contractor's Manufacturing Improvement Projects and Manufacturing Efficiency Projects are both eligible for government financial incentives under the DoD's Industrial Modernization Incentives Program. The shared savings component of the DCF/SSA model occurs in the DoD and defense contractor environment when the contractor proposes a modernization project that will reduce product

costs to the DoD but will not be economically feasible unless the DoD provides some monetary incentive, such as shared savings. For Manufacturing Improvement Projects (those requiring significant capital investment) and Manufacturing Efficiency Projects (those projects requiring little or no capital investment), it is necessary that the DCF/SSA model be used to negotiate the amount of the financial incentive.

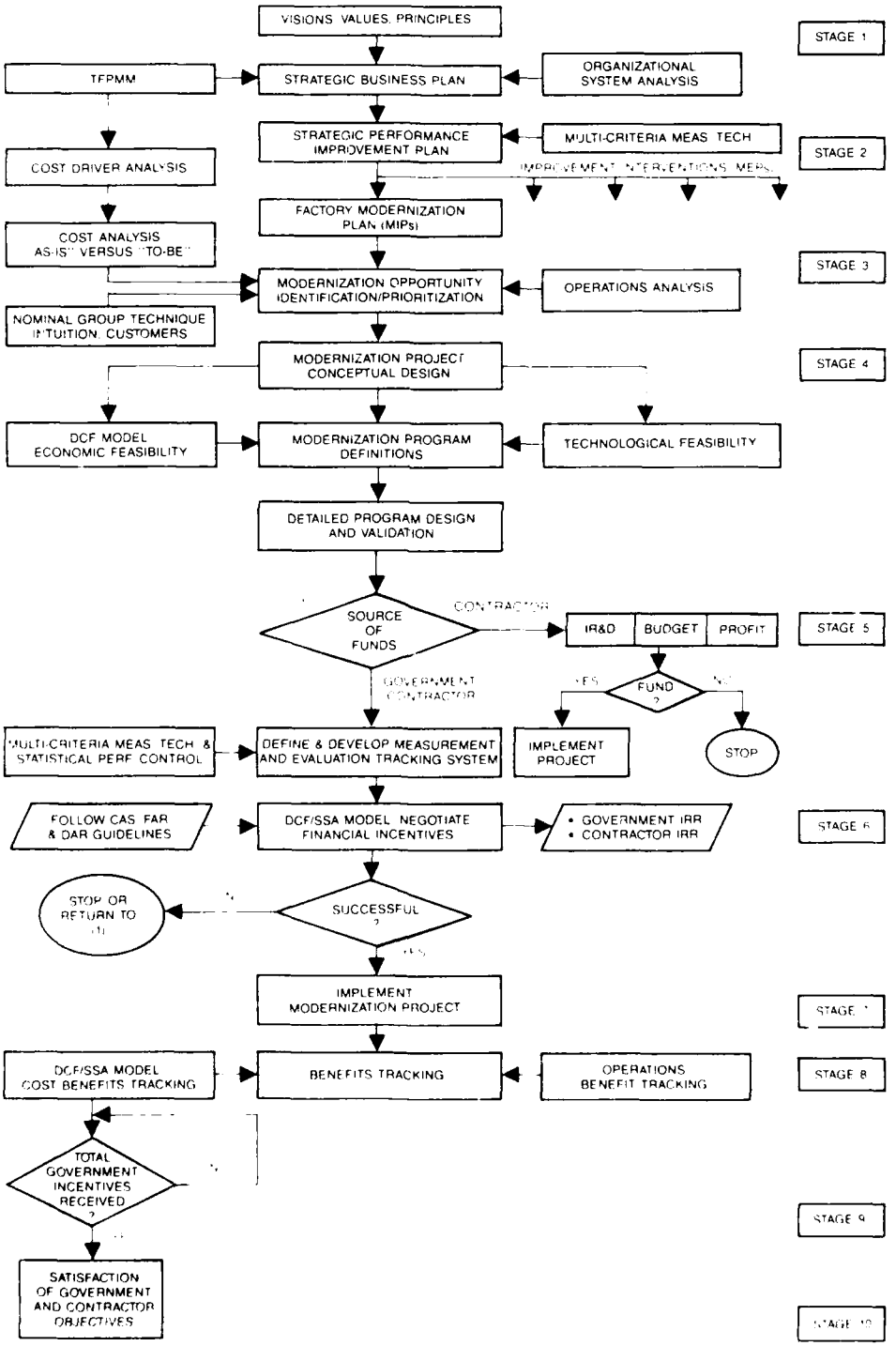
The table below depicts the major differences in applying the DCF model under three scenarios: commercial, defense industry without government-to-contractor incentives, and defense industry with government-to-contractor incentives (i.e., the shared approach). There are four points worth noting. First, in both the commercial and defense industry, the DCF model is typically used to evaluate proposed capital expenditures. Second, the cost and revenue components that make up the net cash flow for a particular year are quite different for a commercial application than a defense industry application. Third, auditing with the DCF model is typically not done in the commercial environment and, as a result, records are not necessarily kept in a fashion that would permit such an audit. However, in the defense industry, if the DCF model is used for a project in which the DoD provided financial incentives through shared savings, the actual savings to the DoD must be verifiable from accounting records. Fourth, an application of the DCF/SSA model must provide considerably more output to the DoD than if a financial incentive to the contractor were not involved.

	(A) COMMERCIAL APPLICATION	(B) DEFENSE INDUSTRY WITHOUT CONTRACTOR INCENTIVES	(C) DEFENSE INDUSTRY WITH CONTRACTOR INCENTIVES
BASIC MODEL	FOLLOWS ACCEPTED CASH FLOW TECHNIQUES	MUST FOLLOW CASH FLOW TECHNIQUES ASSOCIATED WITH THE DEFENSE INDUSTRY (i.e. REGULATED COST ACCOUNTING AND PRICING TECHNIQUES)	SAME AS COLUMN B, EXCEPT CASH FLOW INCLUDES A "SAVINGS SHARE" RETAINED BY THE CONTRACTOR, AS NEGOTIATED. ALSO, THE DOD MAY PROVIDE INITIAL FUNDING
CASH FLOW DATA INPUTS	FOLLOWS CONVENTIONAL CAS GUIDELINES RELATIVE TO EXPENSE AND CAPITAL DEFINITIONS, DEPRECIATION METHODOLOGY, TAX LAWS, ETC	FOLLOWS CAS, DAR, AND FAR GUIDELINES	SAME AS COLUMN B, PLUS ALL THE POLICY GUIDELINES FOR THE NEGOTIATION OF INCENTIVES. AS AN EXAMPLE, FOR AN IMIP, PERCENT SAVINGS RETAINED, SHARING PERIOD, TOTAL SAVINGS AMOUNT, AND RETURN ON INVESTMENT (ROI) ARE NEGOTIATED
MODEL OUTPUT	PROVIDES FINANCIAL INDICATORS TO EVALUATE ESTIMATED VERSUS ACTUAL PROJECT RESULTS. AUDITING IS TYPICALLY NOT DONE	SAME AS COLUMN A	MUST SHOW DETAILS OF CASH FLOWS FOR BOTH THE CONTRACTOR AND DOD WITH AND WITHOUT INCENTIVES FOR EACH. THE CONTRACTOR MUST EVALUATE THE PROJECT'S ECONOMIC FEASIBILITY, VERIFY THE NEED FOR DOD INCENTIVES, AND TEST AND TRACK SHARED SAVINGS TO NEGOTIATED ROI. IF THE SAVINGS RATE IS FASTER THAN NEGOTIATED, THE CONTRACTOR MUST READJUST SAVINGS SO THE MAXIMUM NEGOTIATED SAVINGS ARE NOT EXCEEDED

A Performance Measurement Methodology for Aerospace and Defense Contractors

Up to this point, we have discussed five state-of-the-art measurement techniques and some basic statistical techniques. Individually, none of these techniques can satisfy an A&D Contractor's measurement needs. Collectively, they represent a comprehensive and integrated approach to measurement. The methodology depicted on the opposite page focuses on decisions associated with modernization investment projects and modernization efficiency projects. This investment-oriented approach is a key element to improved performance in the A&D Contractor Community.

Stage 1 indicates the importance of driving the quality and productivity improvement process from the results of the planning process. The Total Factor Productivity Measurement Model (TFPMM) is used at this stage as an integral component of business planning to support capital budgeting decisions, budget planning and development, and pricing strategies. The Multi-Criteria Performance Measurement Technique is used to measure the impact of these plans on overall system performance.


VISIONS VALUES PRINCIPLES
STAGE 1
TFPMM
STRATEGIC BUSINESS PLAN
ORGANIZATIONAL SYSTEM ANALYSIS
STRATEGIC PERFORMANCE IMPROVEMENT PLAN
MULTI-CRITERIA MEAS TECH
STAGE 2
COST DRIVER ANALYSIS
FACTORY MODERNIZATION PLAN (MIPs)
COST ANALYSIS AS-IS" VERSUS "TO-BE"
STAGE 3
MODERNIZATION OPPORTUNITY IDENTIFICATION/PRIORITIZATION
OPERATIONS ANALYSIS
NOMINAL GROUP TECHNIQUE INTUITION CUSTOMERS
MODERNIZATION PROJECT CONCEPTUAL DESIGN
STAGE 4
DCF MODEL ECONOMIC FEASIBILITY
MODERNIZATION PROGRAM DEFINITIONS
TECHNOLOGICAL FEASIBILITY
DETAILED PROGRAM DESIGN AND VALIDATION
SOURCE OF FUNDS
CONTRACTOR
IR&D
BUDGET
PROFIT
STAGE 5
GOVERNMENT CONTRACTOR
YES
FUND ?
NO
MULTI-CRITERIA MEAS TECH & STATISTICAL PERF CONTROL
DEFINE & DEVELOP MEASUREMENT AND EVALUATION TRACKING SYSTEM
IMPLEMENT PROJECT
STOP
FOLLOW CAS FAR & DAR GUIDELINES
DCF/SSA MODEL NEGOTIATE FINANCIAL INCENTIVES
• GOVERNMENT IRR
• CONTRACTOR IRR
STAGE 6
STOP OR RETURN TO
SUCCESSFUL ?
YES
IMPLEMENT MODERNIZATION PROJECT
STAGE
DCF/SSA MODEL COST BENEFITS TRACKING
BENEFITS TRACKING
OPERATIONS BENEFIT TRACKING
STAGE 8
TOTAL GOVERNMENT INCENTIVES RECEIVED ?
STAGE 9
SATISFACTION OF GOVERNMENT AND CONTRACTOR OBJECTIVES
STAGE 10

Stage 2 represents the process of analyzing data for the division, factory, or project in an attempt to identify target areas for improvement through cost driver analysis. Both the TFPMM and Cost Definition (CDEF) Methodology are used at this stage. The TFPMM is used for cost driver analysis. The CDEF Methodology is employed to assist in the development of "as-is" cost baselines. Areas for improvement are identified.

Stage 3 represents the process by which specific improvement projects are identified. The Nominal Group Technique (NGT) can be used to generate consensus regarding improvement projects (see Chapter 4 for a description of the NGT). The contractor then evaluates the improvement projects against Stage 2 to ensure quality and projected impact.

Stage 4 is the point at which actual selection of projects takes place. A variety of decision analysis techniques can be used to determine which projects are worthy of further development. The CDEF Methodology develops and compares "as-is" costs in relation to "to-be" costs to select projects with the greatest potential for improvement. The Discounted Cash Flow (DCF) model is used to assess the economic feasibility of each project.

Measurement

Stage 5 is a critical step and involves an analysis of funding sources available to support the projects. Various decision analysis methods are required at this stage, depending on the funding source.

Stage 6 represents the political reality of the negotiation process associated with obtaining support for improvement projects. The Discounted Cash Flow/Shared Savings Approach (DCF/SSA) model plays a critical role in negotiating government-to-contractor financial incentives.

Assuming the funding for the project is approved, *Stage 7* represents the implementation phase. Many, if not all, government-supported investment programs require cost-benefit tracking, *Stage 8*. Did the government and the taxpayer obtain the desired/predicted performance improvement? Improved measurement techniques such as CDEF and the DCF/SSA model play a key role in answering this question. The Multi-Criteria Performance Measurement Technique and Statistical Performance Control play a role in measuring the impact on system performance.

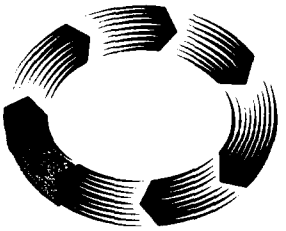
Stage 9 represents the point at which these government-to-contractor incentives become a reality. *Stage 10* is the achievement of desired outcomes for the contractor and the government.

Some Closing Remarks on Measurement

You and every one of your managers, management teams, and employees is, in a sense, a pilot. They are managing ("flying") complex systems. They need data and information in order to plan, make decisions, and solve problems. How the data and information are stored, retrieved, and portrayed will determine the extent to which your measurement systems really support the management process. Good measurement and evaluation systems don't just happen. They evolve as a result of planned, systematic, and conscious efforts to improve their quality. The quality of the instrument panels, scoreboards, and information systems you have are no less important than the quality of the instruments and controls used by the Boeing 757 pilot. None of us would want to fly in a plane that had one instrument telling the pilot "We're OK-We're Not OK." We cannot be willing to "take a ride" with organizations that have essentially the same type of logic built into their information systems (e.g., we made money this quarter – we're OK; we didn't make money this quarter – we're not OK).

Summary

In this chapter we've presented measurement theory, approaches, and techniques that support your new improvement process. Measurement plays a critical role in this process. Measurement provides insight into where change is needed or improvement leverage exists, provides feedback to drive further improvement, and supplies data with which we can assess and evaluate performance. Properly designed measurement and evaluation systems ensure we are striving to constantly improve performance. Effective measurement begins and ends in improvement, not control. In the next chapter we highlight the notion of constant and continuous improvement.



Improvement^{n}

Chapter 6
Improvement to the "nth power"
Continuous Total Performance Improvement Strategy

Key Points:

1. Improvement is a never-ending process. Your culture, and measurement and reward systems must support it. (p. 132)

2. Your organization must rely on both step-function improvement strategies and continuous improvement strategies. (p. 132)

3. A total improvement strategy requires that you combine more proactive step-function strategies with continuous improvement strategies. (p. 134)

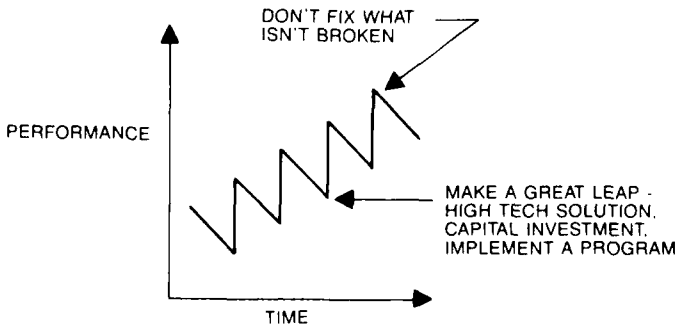
4. The combined strategies will yield a higher rate of improvement. (p. 135)

Different Strategies for Improvement

Improvement doesn't end in measurement; it is never-ending. What we've outlined in this guide is a process, not a program, for constant and continuous performance improvement. This process helps integrate continuous improvement strategies with the best features of step-function improvement strategies to yield a total performance improvement strategy. Let's examine these three different strategies for improvement.

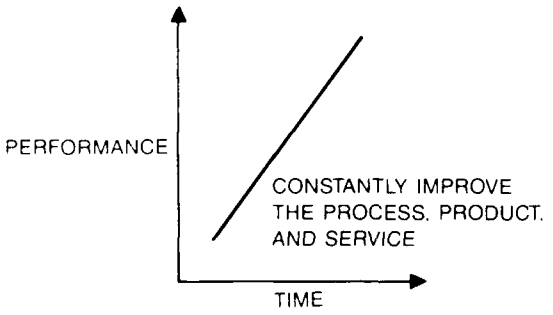
Step-Function Strategies

Step-function strategies focus primarily on great leap, incremental improvement. With such a strategy, we tend to improve performance only when a crisis occurs or when performance has slipped so low it becomes obvious something needs to be done. The step-function strategy is typically reactive and tends to focus on larger capital investments and implementation of programs.



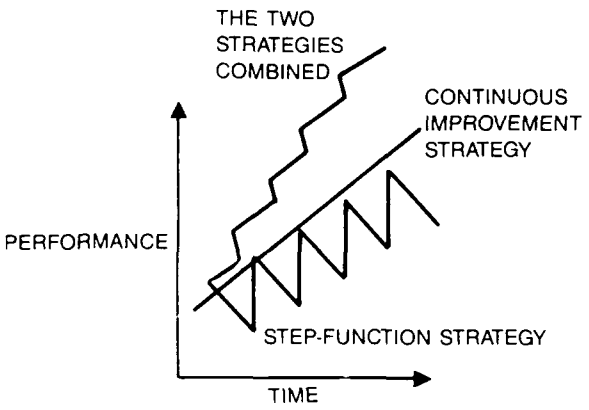
Continuous Improvement Strategies

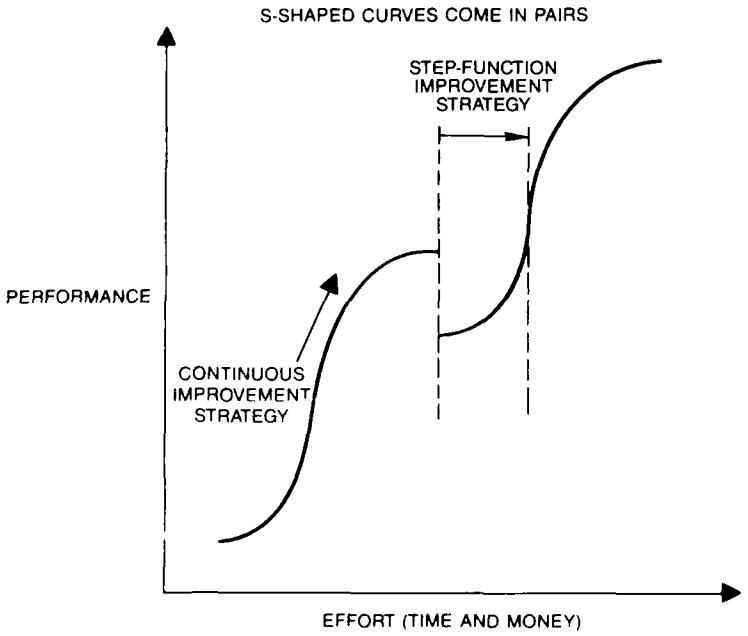
"When the Japanese advantage in quality became obvious in the early eighties, it was fashionable among American managers to attribute it to the Japanese lead in robots . . . but . . . the Japanese success had come not from technology but from manufacturing skills. The Japanese had moved ahead of the Americans when they were at a distinct disadvantage in technology. They had done it by slowly and systematically improving the process of their manufacturing in a thousand tiny increments. They had done it by being there, on the factory floor, as the Americans were not." (Halberstam 1986, p. 693)



Continuous improvement strategies focus on performing better tomorrow than today. They involve different management processes and practices, and tend to have a steeper improvement slope over the long run than step-function strategies. They require everyone, at all levels, to be involved in the improvement process.

Total Performance Improvement Strategy





(SOURCE: FOSTER 1986)

Continuous improvement strategies merged with more proactive step-function strategies provide organizations with the best performance improvement. Both strategies combined reflect that strategic business planning and performance improvement planning are being managed in an integrated way and together yield a much higher rate of improvement over the long run.

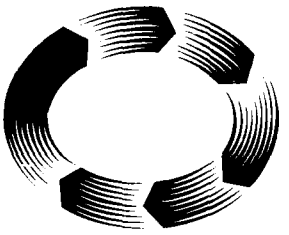
In *Innovation,* a recent book by Richard Foster, Director of McKinsey & Company, the notion of S-shaped curves was presented. An S-shaped curve represents the learning curve associated with a technology, where technology is broadly defined as a way of getting something done. The S-shaped curve suggests that early in the use of a new technology, we are inefficient and gradually learn to improve our proficiency with that technology. After a period of time, we reach a point where technology is being used efficiently and returns are diminished. Foster points out that the "winners" begin searching for the next technology, or S-shaped curve, while "losers" keep trying to make the old technology more efficient. Continuous improvement strategies help us move up an S-shaped curve faster than our competitors. Step-function strategies represent the search for the next S-shaped curve. Both strategies are needed and important and are a part of the performance management process.

Summary

We cannot emphasize enough that improvement is a never-ending process. The world will not wait for your organization to rest on the successes of past improvement. In this rapidly changing world, an organization cannot afford to play "catch-up." Constant and continuous improvement requires:

- Embracing the improvement process as a way of managing (not as a "program" to fix the organization)
- Managing the improvement process with the same level of discipline given to managing budgets and technology
- Sharing information, knowledge, power, and rewards
- Managing culture
- Patience – real change, and the impact of that change, takes time
- Hard work
- Effective implementation.

Effective implementation of a total performance improvement stategy will drive your organization to performance levels once thought impossible. Once achieved, these levels of performance are difficult to maintain. Many managers are facing that challenge today. The next chapter, entitled "Maintaining Excellence," addresses this challenge.



Excellence

Chapter 7
Making Quality and Productivity a Way of Life

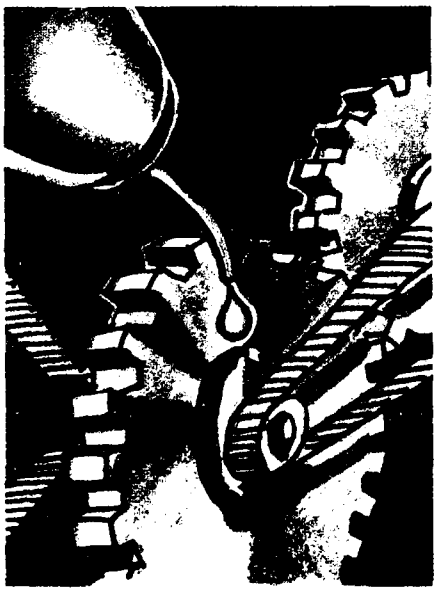
Key Points:

1. Achieving excellence is a difficult challenge; maintaining and building on excellence is an even greater challenge. (p. 138)

2. We present lessons learned on maintaining excellence by leaders and managers in A&D and other fields. (p. 139)

3. Developing a grand strategy and roadmap for change is critical to your organization's success. (p. 143)

Maintaining Excellence is a Difficult Challenge



Maintaining excellence completes the cycle of performance improvement and also begins a new cycle of challenge. Achieving excellence is a difficult challenge; maintaining and building on excellence is an even greater challenge that requires constantly redesigning and evaluating your improved management process.

We compared and contrasted performance levels in the typical U.S. organization with those of the New Competition and have, hopefully, raised some doubts as to whether our standards of excellence make us competitive in the world market.

The rules are changing, and for those willing and able to adapt, the opportunities are infinite.

We have examined the necessary strategic factors an organization must employ in order to capitalize on these opportunities:

- Planning Processes (quality and productivity improvement planning)
- Measurement Systems (improvement-oriented systems)
- Quality and Productivity Management Practices (continuous improvement strategies, total quality management, management of participation, gainsharing)

These strategic factors, to which the organization needs to allocate resources, have been listed in detail by the literature in this area. We have made no attempt here to review the complete list of strategic factors we identified in the literature or upon which industrial managers may concentrate. We did, however, conclude that a few broad areas required close attention. We believe that it is essential for your management team to identify situationally specific strategic factors which would lead to improvement in your organization, and to then take action on them.

Our study for the DoD and your industry reveals that the right place to begin, in order to systematically respond to the challenges posed by the New Competition, is by improving the management processes of an organization.

We have solicited the wisdom of some great sports coaches, business leaders, and management theorists; we feel there is much to be learned from their insights.

Reflections on Maintaining Excellence

"We thrive on the theory that you either get better or worse; you never stay the same. If you are not working hard to improve, then you are forming bad habits that make you worse."

Denny Crum, Head Basketball Coach,
University of Louisville

Excellence

"There is no simple, single way to describe what it takes to sustain 22 consecutive years of increased earnings and 36 consecutive years of increased dividends . . . there isn't any single action that accounts for what we are accomplishing – it's thousands of actions being made daily – some large, some small – but each vitally important to our performance."

"We are facing more competition than ever before . . . I accept the fact of competition, but I reject the notion of its inevitable intrusion at our expense! Competition is not an abstract concept – not a faceless organization. Competition is another human being – just as you are – who is saying: "I can offer customers greater value than the human beings at Dun and Bradstreet. I can work smarter and faster to understand what benefits the customer is looking for. I have a greater ability than the men and women at D&B to understand and correctly match my costs to those benefits. I have a greater resolve than D&B people to effectively manage my costs: and in so doing my ratio of benefits to price will constitute customer value at a level which will compel the customer to leave D&B and come with me." In short, competition is an individual human being who is personally challenging each of us as human beings for the most important turf of all – the business of a customer . . . And if the customer does prove the competitor right, we will have no one to blame but ourselves . . . Our ability to prevail in the face of competition rests on the men and women of D&B . . . who understand that to effectively compete requires that one be customer focused in the broadest sense – and that to be customer focused requires a taste

and resolve for change; a taste and resolve for action with a sense of urgency; a taste and resolve for a relentless focus on quality."

Charles Moritz,
Chairman and CEO,
The Dun & Bradstreet
Corporation

"Consistency is the truest measure of performance. Almost everyone can have a great day, or even a good year, but true success is the ability to perform day in and day out, year after year, under all kinds of conditions. Inconsistency will win some of the time; consistency will win most of the time."

George Allen, Chair,
President's Council on Physical Fitness

"Management must create consistency of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs."

W. Edwards Deming

Constant improvement to maintain the excellence achieved, while constantly striving to improve other aspects of your performance, is the recurring theme among the great teams and organizations.

"Winning is the most misunderstood phenomenon today. Winning isn't the most important thing, preparing to win is."

Bobby Knight, Head Basketball Coach,
Indiana University

Warren Bennis and Burt Nanus, in their book, *Leaders: The Strategies for Taking Charge*, identify four major themes that all ninety leaders they studied considered important: (1) attention through vision; (2) meaning through communication; (3) trust through positioning; and (4) the deployment of self through positive self-regard and the Wallenda factor (the capacity to embrace positive goals, to pour one's energies into a task). Maintaining excellence requires good leadership. All the coaches and managers we cite here link effective leadership to good managerial skills. You cannot maintain excellence without leadership.

"Excellence requires DISCIPLINE . . . Discipline not to take the easy way out, discipline to forego "nice-to-have" features, discipline to minimize changes, discipline to demand a quality product, discipline to treat a customer fairly even when it costs, and discipline to "tough-out" and solve the problems which will occur in even the best-managed undertakings."

Norman R. Augustine,
President
Martin Marietta Corporation

A commitment to excellence: avoiding complacency, setting clear goals and paths, establishing a positive self-regard and guiding principles – these are the powerful lessons and common threads in the messages from great managers and coaches.

"It is one thing to recognize the need for quality and generally strive to achieve it. It is another to give it first priority in everything a company does."

Tom Murrin, Past-President,
Energy and Advanced
Technology Group,
Westinghouse Electric
Corporation

Excellence, as we have seen, can be maintained by continually establishing realistic goals, by understanding the value of temporary setbacks that reestablish drive, and by assembling a team of individuals committed to achieving and maintaining success. We value these insights and hope they serve to reassert our recommendations on quality and productivity management in the defense industry. There is no one best way for any given organization, and becoming excellent is quite different from maintaining excellence.

A Roadmap for Change

At some point in time, the translation, interpretation, and application of these concepts must take place. Effective application takes place systematically, as we have suggested throughout this document, but how does implementation take place in your organization or within the DoD?

1) Begin by developing a "roadmap for change," a Grand Strategy that is unique to your organization. Use the Quality and Productivity Improvement Planning Process described in Chapter 3 to accomplish this. Involve the entire management team in this process in order to establish a unified purpose throughout the organization. Start this process at the top of the organization and slowly move the process down and across the organization over a two- to five-year period. Implement proposals for performance improvement as you progress.

2) Employ subtle educational interventions in the planning processes in order to constantly improve awareness of and support for new management practices. Let the planning process guide training efforts that support the new management practices (people in the system will identify when and where training is needed).

3) Develop a critical mass of champions and "masters" as you implement this performance improvement planning process. Deming defines a master as being one who has knowledge, willingness, skills, and experience. Without masters, the improvement process will fail.

4) Target key management processes as primary areas for adjustment early during the establishment of performance improvement planning. Our study identified several processes: measurement systems, compensation management systems (to include gainsharing), management of participation, and total quality management.

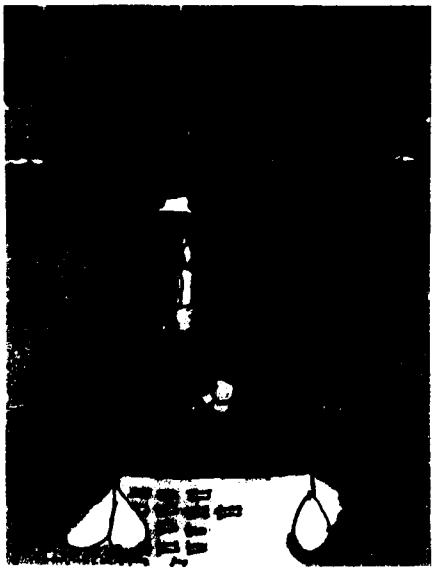
5) Apply the basic concepts underlying the statistical process control to the management processes and strategies presented in this guide:

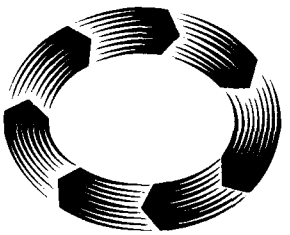
   a) Establish a management process for quality and productivity improvement planning at all levels in the organization. This will increase the level of proactivity relative to performance improvement that is necessary to respond to the new competition. Harnessing the insights, wisdom, energies, and knowledge of all employees in the organization in an effective and efficient fashion is what we mean by management of participation. The planning process presented in Chapter 3, when instituted organization-wide, can be used to drive the specific initiatives identified for your organization.

   b) Control the variance – ensure everyone implements the process as specified.

   c) Shift the mean – move the process down and across the organization; improve your execution of the process.

   d) Recycle with a focus on constant improvement – incorporate lessons learned from each cycle in the redesign of your improved management process.





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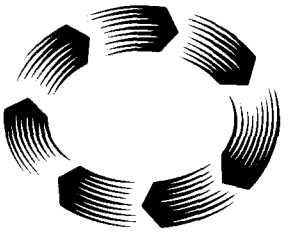


Appendix A

Planning Process Examples

Sample Output for Step 1: Organizational Systems Analysis

Vision (Corporate Long-Range Objectives) (from a Naval Ordnance Station, Corporate Guidance Document)

1. To be internationally recognized as a center of engineering and manufacturing excellence in the areas of guns, rockets, and missile propulsion; energetic chemicals; missile weapon simulators and training shapes; ordnance devices; explosives; warheads; and special weapons.
2. To achieve and maintain the best record of employee safety and environmental protection throughout the ordnance industry.
3. To continually assess and adjust resource allocations and technical core capabilities so as to maximize effectiveness, competence, and productivity of the work force.
4. To constantly improve productivity and quality in our products and services.
5. To maintain a mobilization readiness posture and modernize our facilities and equipment through an aggressive investment strategy.
6. To maintain a quality of work life program that includes support for the Navy's Affirmative Action initiative.
7. To be the role model for excellence in the area of business practices.
8. To provide timely and quality response for products and services to the Fleet and all other customers.

Appendix A

Mission Statement
(from the Ford Motor Company)

Ford Motor Company is a worldwide leader in automotive-related products and services as well as aerospace, communications, and financial services. Our mission is to improve our products and services to meet our customers' needs, allowing us to prosper as a business and to provide a reasonable return for our stockholders, the owners of the business.

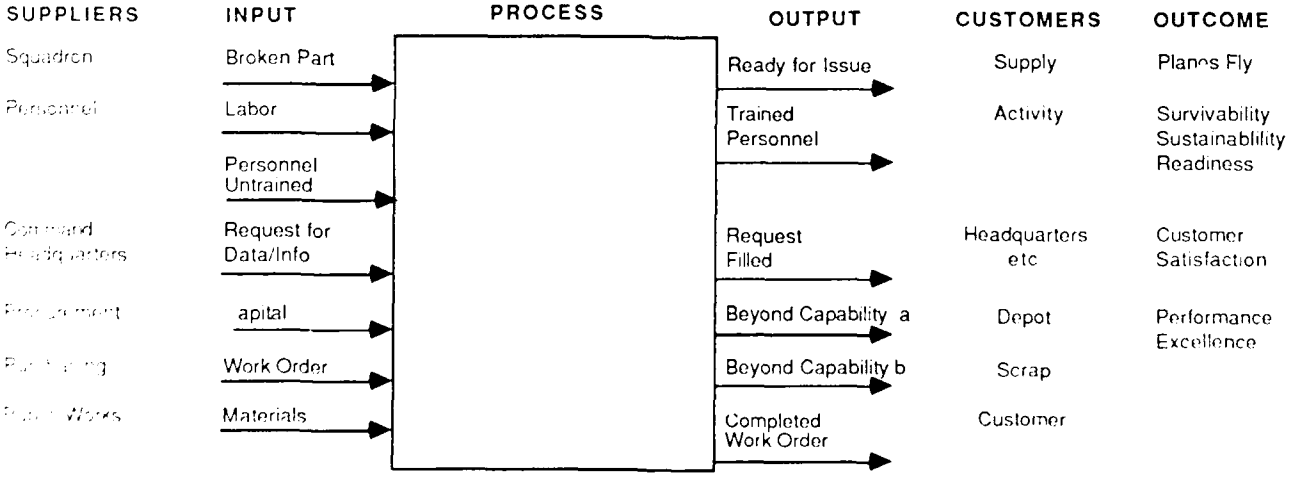
Guiding Principles
(from the Naval Aircraft Maintenance Organization's Productivity/ Performance Improvement Plan)

- We believe in the importance of people as individuals. Since people are our greatest asset, we will maintain an atmosphere of trust which fosters innovation, motivates superior accomplishments, and promotes personal growth.
- We operate in an honest and straightforward way. Open communication is promoted. We deal with each other, our customers, and our community with integrity.
- We are committed to providing necessary facilities, tools, and support for our people.
- We are committed to being the best in all we do.
- We will work efficiently, effectively, and with maximum productivity. We will commit to excellence, to a relentless pursuit of continuous improvement, and to removing barriers to increased performance, productivity, and timeliness in all we do.

Appendix A

- We believe in superior quality and service. We will improve the quality of what we do because better quality improves mission performance, increases productivity, and reduces costs.
- We are sensitive and responsive to the needs of both our internal and external customers. Our success is measured by their satisfaction.
- We are a responsive member of our community. We actively participate in and support civic programs.

Input/Output Analysis (Partially Completed IOA Chart for an Aircraft Intermediate Maintenance Department)



Appendix A

Internal Strategic Analysis
(Partial List from the Department of Navy's Total Performance/Productivity Improvement Action Plan)

1. Nondefined measures of effectiveness (weakness).
2. Shortfalls in assignment and distribution of personnel will continue (weakness).
3. Lack of understanding or sensitivity between headquarters and field (weakness).
4. Lack of resources for modernization (weakness).
5. Staid bureaucracy (weakness).
6. Rare opportunity to change personnel system (weakness).
7. Maze of regulations to be dealt with (weakness).
8. Quality of doers (strength).
9. Growing grassroot sentiment for change (opportunity).
10. Strong leadership from top (strength).
11. Public perception of government not going to change (threat).
12. Losing competitive edge and attracting skilled personnel (weakness and threat).
13. Opportunity to make change (strength and opportunity).
14. Inadequate planning, moving too fast, time constraints (weakness).
15. Consider all seven factors of performance (efficiency, effectiveness, quality, productivity, quality of work life, innovation, and budgetability) (strength).
16. Rapid personnel turnover (weakness).
17. Presidental directive (opportunity).
18. Questionable data base for base year (weakness).
19. Lots of fragmented programs but overall low awareness (weakness).

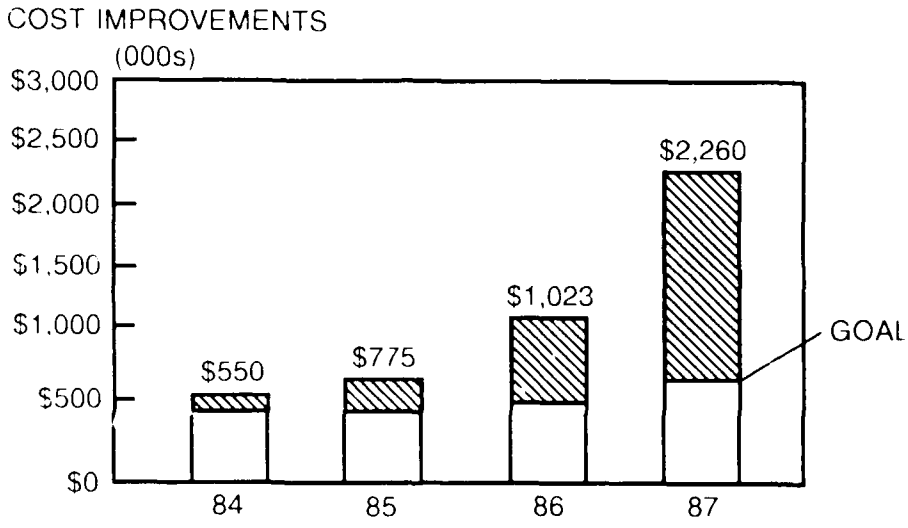
Appendix A

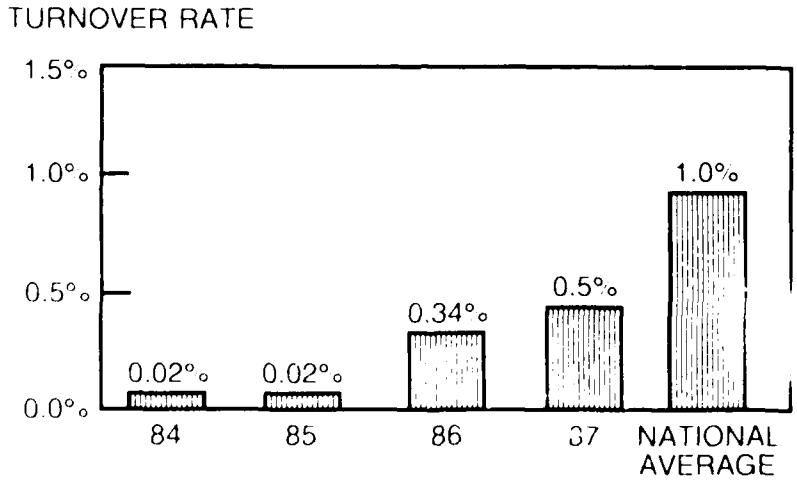
External Strategic Analysis
(Partial List from the Department of Navy's Total Performance/Productivity Improvement Action Plan)

1. Micromanagement from Congress (weakness and threat).
2. Rising unconventional warfare threat (threat).
3. Declining industrial base (weakness and threat).
4. Fragmented national effort for improvement (weakness).
5. Competition from the Russian Navy (threat).
6. Timely receipt of goods (strength).
7. Educational system deficiencies (weakness and threat).
8. Decreasing budget opportunity, Gramm-Rudman-Hollings Act (threat).
9. Economic strength of country (strength).
10. Growing technology and information systems (strength).
11. Statutory limitations (weakness).
12. Blanket application of private sector solutions (weakness).
13. Reorganization of DoD (opportunity).
14. Decreased retention of high-tech personnel (weakness).
15. Change in Executive Administration in 1988 (opportunity or threat).
16. Roadmaps to change do exist (strength and opportunity).
17. Accepting low bids; part support procurement ignoring quality and timeliness issues (weakness).
18. Excessive reliance on consultants (weakness).
19. Pressure of public opinion (threat).
20. Competition for dollars from other government agencies (threat).

Appendix A

Current Performance Levels
(Partial Output for a Manufacturing Plant)





Appendix A

Roadblocks
(Partial List from a Manufacturing Company)

Date: June 15, 1987
Participants: 8 Senior Managers
Facilitator: Scott Sink
Task Statement: Please identify roadblocks to quality, productivity, and performance improvement.

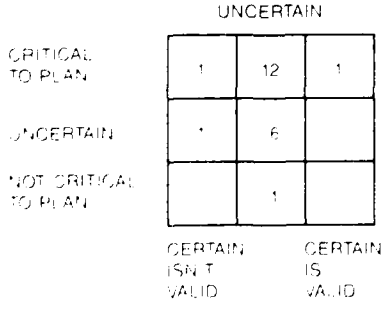
Roadblocks	Votes Received (7 = Most Important 1 = Least Important)	No. of Votes Received/ Total Vote Score
1. Conflicting corporate requirements on capital (e.g., earnings per share versus growth versus earnings as percent of sales). In general, corporate performance indicators	7-7-7-6	4/27
2. Unclear understanding at all levels of the corporate/division vision (mission) • Lack of acceptance of established missions	7-7-7-1-1	5/23
3. Overcoming employee resistance to change (e.g., employees see productivity gains as a threat) • Pride in the way we've done things in the past	5-4-3-3-3-2	6/20
Lack of common goals between functional areas	6-5-4-2	4/17
5. Need for consolidation of product lines • Small runs caused by wide product base • Lack of standardization of parts and components	6-6-4	3/16
6. Conflicting priorities	6-5-3-1	4/15
7. Lack of proper training techniques throughout the organization	6-4-2-1	4/13

Appendix A

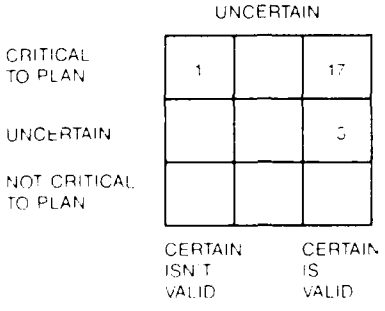
Sample Output for Step 2: Planning Assumptions

The Importance-Certainty grid examples shown here are from a manufacturing company's strategic plan. Let's take a look at these assumptions. There is fairly strong consensus that Assumption A is critical to the plan; there is however, a strong consensus this is uncertain. Assumption A, therefore, represents an area where contingency plans need to be developed. There is very strong consensus among the group that Assumption C is both critical and valid. The resulting plan, therefore, should contain strategic objectives and action items to address selection and placement, and education and training issues. On the other hand, there is no clear consensus on Assumptions B and D. This indicates these assumptions must be discussed in detail. It may be that the individuals who believed these two assumptions were both critical and valid have data and information which haven't been shared with the group. As such, these grids spark a discussion that is healthy and beneficial. In addition, auditing your plan on a quarterly and annual basis against planning assumptions provides insight into progress to date and into where corrective action needs to be taken (i.e., modifying certain objectives and action items, shifting priorities).

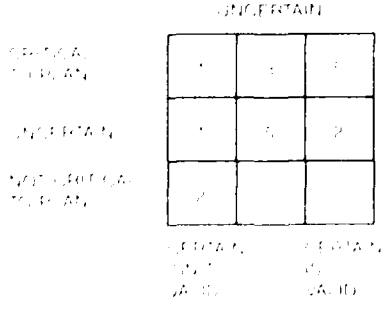
Assumption A
Workload, both level and type of work, will occur pretty much as expected.



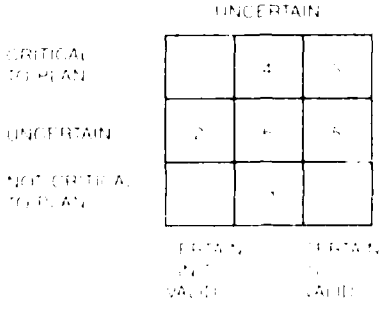
Assumption C
We'll continue to need highly trained and highly qualified personnel.



Assumption B
Competitors will make a major change and continue to improve at a rate believed impossible.



Assumption D
Our customers will become more consumer activists.



Appendix A

Sample Output for Step 3: Performance Improvement Objectives

(Partial List from a Major Federal Government Agency's Performance Improvement Plan)

Group:	Top Management
Date:	January 30, 1988
Facilitator:	Scott Sink
No. of participants:	8 groups (36 participants)
No. of ideas to vote for:	7
Task Statement:	Please identify performance improvement objectives (5-year horizon) for

Superordinate Objectives

1. Complete implementation of the results of this session.
   - Analyze audit and develop a plan for improving priority areas.
   - Complete the development of the performance improvement plan in accordance with this process.
2. Establish mission support contracts to augment in-house engineering capability.
3. Continue emphasis on management of participation and motivation of work force.
4. Develop a fully integrated work force.
5. Actively pursue acquisition of new programs providing challenging work to employees.

Appendix A

Objectives	Votes Received (7 = Most Important 1 = Least Important)	No. of Votes Received/ Total Vote Score
1. Decentralize authority and decision making to the lowest possible level • Eliminate one to two levels of management	7-7-7-7-7-7-7-6-6-6-6-6-5-5-5 4-4-3-3-3-3-3-2-2-1	25/122
2. Review all rules and regulations and eliminate all those unnecessary	7-7-6-6-6-5-5-5-5-4-4-4-4-4-4 3-3-2-2-2-2-1	22/91
3. Develop a consolidated list of road-blocks, analyze and take action to remove	7-7-7-7-7-7-7-5-5-5-4-4-4 3-2-1-1	17/83
4. Reduce internal procurement processing time	7-6-6-6-4-4-4-4-4-3-3-3-3 3-2-1-1	17/64
5. Enhance our existing 5-year facilities/ office requirements and implementation process • Provide improved physical work environment (e.g., facilities and equipment) • Refurbish our office space	7-7-6-5-5-5-4-4-4-3-3 2-2-2-2-2-1	17/64
6. Train replacement managers (former, on-the-job training) • Implement a management development program that includes on-the-job training as a recognized component	7-7-6-6-6-6-5-5-4-3-3 1-1-1-1	15/62
7. Assess current projects for applicability to the strategic plan	7-7-6-6-5-5-5-4-4-3-1	11/53
8. Develop career plan for training all employees	6-6-4-4-4-4-4-2-2-2-1-1	12/40

Appendix A

Sample Output for Key Performance Indicators (from a Manufacturing Company's Strategic Plan)

Goal A – Establish and maintain a Quality of Work Life improvement program

KPIs:
- Completion of project management milestones
- Number of lateral transfers
- Grievances filed (number and dollars paid)
- Sick leave usage
- Number of disciplinary actions
- Accidents (rate and cost)
- Turnover rate
- In-house survey to assess attitudes and beliefs
- Resources consumed on our activities versus budget

Goal B – Establish a master plan for maintaining and upgrading facilities and equipment

Identify and replace outdated facilities and equipment

KPIs
- Quantity of adequate, deficient, or surplus Class I and II property
- Number of accidents due to deficient equipment or facilities
- Cost of scheduled and unscheduled maintenance
- Amount of rework attributable to equipment
- Number of jobs rejected due to lack or inadequacy of facilities
- Performance factor trend
- Success of goal No. 3: reduce cost of ship overhauls

Update electrical generation and distribution

KPIs
- Percent of required capacity available
- Number of unscheduled outages
- Mean time between failures (equipment)
- Critical load path redundancy
- Percent of electrical power redundancy

Appendix A

Sample Output for Step 4: Tactical Objectives (Partial List from a Manufacturing Company's Engineering Task Force)

Group: Engineering Task Force
Date: June 10, 1988
Facilitator: Scott Sink
No. of participants: 6 groups
No. of ideas to vote for: 7
Task Statement: Please identify actions the Engineering Function should start this year to move toward accomplishing its strategic objectives.

Tactical Objectives	Votes Received (7 = Most Important 1 = Least Important)	No. of Votes Received/ Total Vote Score
1. Integrate production engineering and manufacturing engineering • Develop procedures to improve information flow between engineering and manufacturing	7-7-7-5-5-3	6/34
2. Develop procedures to induce all affected disciplines, including the suppliers and vendors in planning and design • Include all affected functions in project planning process	5-3-2-2	4/12
3. Adopt a common project planning tool	7-5-1	3/13
4. Implement capacity planning for product and manufacturing engineering	7-6	2/13

Appendix A

Tactical Objectives (continued)	Votes Received (7 = Most Important 1 = Least Important)	No. of Votes Received/ Total Vote Score
5. Use new corporate design review with participation by all divisions at the reviews • Incorporate design review into original schedule and hold-on time	5-4-2	3/11
6. Reduce total execution time performance requirements	4-4-1	3/9
7. Develop format for submitting and retrieving all ideas on speeding up development	6-3	2/9
8. Establish common data base and means of access and utilization	4-4	2/8

Appendix A

Sample Output for Step 5: Action Teams

Scoping Proposal/Action Plan
(Taken from the Department of Navy's Total Performance/Productivity Action Plan)

Action Item:

All shore activities will establish measures of performance/productivity and develop a yearly 5-year productivity plan by October 1987.

- Who should be involved?

  Each echelon 2 command.

- What has to be done to complete the action item? How might the action item be implemented?

  Identification and awareness of three elements of a performance/productivity plan: cost, quality, and time.

  Identify units of output and input and express them in terms of cost at the activity level, then combine at the Naval Sea, Naval Air, etc., level. Develop methods for measuring these inputs and outputs.

  Measure product reliability in terms of in-service failures and monitor specific trends.

- When must things be done (i.e., develop a macromilestone chart)?

  February 1987 – Each command will distribute the Department of Navy Total Performance/Productivity Action Plan to each subordinate activity with guidance on development of the yearly 5-year productivity plan.

  August 1987 – Each activity is to establish measures with baselines and a draft of their plan to their command level.

  October 1987 – Each activity will submit their first plan.

- What are the measures of success? How will we know if we are successful?

  An organized approach to productivity improvement.

  Increased visibility for performance/productivity improvement efforts.

  Improved support to the Fleet and Marine Corps.

- What's the next or first step?

  Involve down to activity level in the identification of units of inputs and output.

Appendix A

Sample Output for Step 7: Measurement and Evaluation

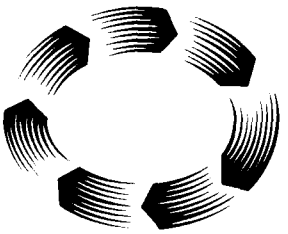
(Partial Listing from a Naval Shipyard's Strategic Plan: Shipyard Performance Measures)

Group: Shipyard Strategy Board
Date: July 25, 1988
Facilitators: Scott Sink and Ken Kiser
No. of participants: 24
No. of ideas voted for: 7
Task Statement: Identify measures which will tell you, as a top management team, how the shipyard is improving as a result of the Strategic Plan.

Superordinate Measures:

1. Number of major variances from plan (cost, schedule, quality)
2. Progress against goals
3. Quality indicators

Measures	Votes Received (7 = Most Important 1 = Least Important)	No. of Votes Received/ Total Vote Score
1 Cost of ship availabilities in comparison to baseline trends • Customer feedback	7-7-7-7-6-6-6-6-5-5-5-5-3-3	14/78
2 The degree to which products meet customer expectations	7-7-7-7-7-5-4-4-3-2-2-1-1-1	14/58
3 Expenditures (Labor and Material) against standards	7-7-7-7-6-5-4-4-4-2-2-2-1	13/58
4 Number of qualified personnel against plan	7-6-5-5-5-5-4-4-4-3-3-2	12/53
5 CS^2 data (Cost Schedule/Cost Control System)	7-7-6-6-6-6-5-5-4-1	10/53
6 Weighted schedule adherence *(normalized)*	7-6-6-6-6-6-5-4-3-1	10/50
7 Fixed price variance • Actual labor costs • Resource cost by process (e.g., equipment overhaul, ship check)	7-5-4-3-3-3-2	7/27



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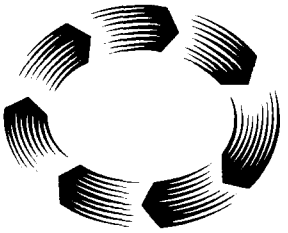

Appendix C

History of the Managing Quality and Productivity Guide Project

Introduction

Individuals in industry, government, and academia have come together in this five phase study to research best practices in the area of quality and productivity management, and capture these practices in a document that:

1. Sets the proper tone for quality and productivity measurement and improvement
2. Communicates the fundamentals of the performance/quality and productivity management methodology
3. Moves individuals in government and industry from the "narrow view" of measurement (e.g. Mil. Std. 1567)
4. Demonstrates that measurement leads to improvement

The purpose of this document was not to make the task of improving quality and productivity seem deceptively simple. Instead, the purpose was to present, in a succinct and clear fashion, a structured process leading to quality and productivity management that is being practiced in excellent U.S. companies.

Appendix C

Review of Study

The overall goal of this five-phase study was to identify, research, and develop (if necessary) processes and techniques that will help an Aerospace and Defense (A&D) company improve its performance. The government understandably wants/needs to improve the performance of defense-related systems for acquisition purposes and readiness, survivability, and sustainability purposes. The contractor understandably wants to improve its performance, so it will be competitive and grow and survive in both the short and long-term.

The initial phases of the study (Phases I, II, and III) focused on productivity measurement and evaluation methodologies and models which would effectively integrate with and support government-to-contractor methodologies. The focus expanded in Phases IV and V to include processes and techniques for quality and productivity management.

Phase I was conducted by the Army Procurement Research Office (APRO) and involved a survey of current productivity measurement practices in the defense contractor industry. The purpose of Phase I was to 1) identify and describe current productivity measurement practices in the defense contractor community, and 2) develop specific definitions of contractor productivity appropriate to the defense industry. The study report in 1984 stated:

1. Contractors ranked profitability as the most critical dimension of performance; effectiveness, quality, efficiency, and productivity followed.

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2. Problems encountered by contractors *measuring productivity were usually due to* difficulties in identifying and quantifying inputs and outputs.

3. There was no evidence of total factor productivity measurement.

4. Production cost visibility varied widely among contractors. Indirect cost visibility is becoming increasingly important due to shifts in cost drivers.

5. Tracking the impact of improvement interventions is difficult, especially in indirect areas.

6. Investments were made for mostly competitive and technological reasons, rather than for cost reduction on current contracts.

Phase II, conducted by the Oklahoma Productivity Center (Sink) and the Maryland Center for Productivity and Quality of Working Life (Tuttle), focused on identifying and describing available productivity measurement techniques and developed a taxonomy for these techniques. The study concluded that:

1. Knowledge of specific productivity measurement techniques is not widespread.

2. State-of-the-art techniques require substantial effort to implement.

3. Some of the macro-measurement and surrogate techniques may be adequate for an individual manager's needs.

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The goal of Phase III was to evaluate the productivity measurement techniques identified in Phase II: the Total (or Multi) Factor Productivity Measurement Model (TFPMM), Price Waterhouse's Cost Definition Methodology (CDEF), and the Discounted Cash Flow/Shared Savings Approach (DCF/SSA). A fourth approach investigated was LTV's integrated productivity measurement system: this system incorporates elements of the TFPMM, CDEF (cost benefit analysis and tracking), and DCF/SSA. The VPC at Virginia Tech was contracted to execute the Phase III contract. Four subcontractors were involved: Maryland Center for Productivity and Quality of Working Life, LTV, Price Waterhouse, and Westinghouse. The study concluded:

1. Individually, none of the three models tested would accomplish all the objectives desired by contractors and the government.

2. A methodology which incorporated the use of a variety of measurement and evaluation models was required; these three models, when viewed together, constituted a potentially satisfactory methodology to accomplish contractor and government objectives.

3. Variances in operating systems, management styles, pressures, priorities, perceived problems and opportunities, and skilled/competent management personnel will very likely make it difficult to translate and transfer models and methodologies from one company to the next.

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The Phase IV research involved a field test of the TFPMM, CDEF, and DCF/SSA models; completion of the quality and productivity management methodology designed in Phase III; design and development of a draft document to communicate the principles, philosophies, tools, and techniques of quality and productivity management; and development of detailed plans for a series of guide evaluation workshops to be held in Phase V.

The goal of Phase V was to produce a final version of the Phase IV draft document. The next section describes the strategy for development of the final draft.

Strategy for Development

Our strategy for developing a document that would reflect, present, and feature best practices in the areas of quality and productivity management was to create a high quality product that would have high acceptance in the A&D industry. In order to accomplish these goals, we recognized the need to have knowledgeable people draft the document and then have a broad, representative sample of key managers from both government and industry critique and modify the document. We developed a stratified sampling strategy for selecting persons from industry to attend an evaluation workshop. Mr. Richard Engwall of Westinghouse was our chairperson of the selection committee and also chaired the Government-Industry Review Board. The evaluative feedback from these workshops improved the quality of the guide and provided data for many of the tables and figures we used.

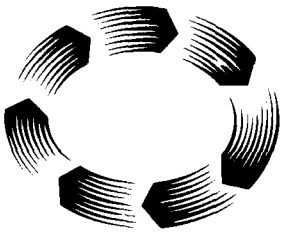
Appendix C

Our strategy for success also called for writing a document that utilized as prototypes, at least from a professional standpoint, Honeywell's Aerospace and Defense *A&D's Future and You: A Performance Improvement Guide* and the Department of Navy's *Best Practices: How to Avoid Surprises in the World's Most Complicated Technical Process – The Transition from Development to Production*. We believe we gathered the right team to write the guide and in a style that captured the imagination and attention of management in the A&D community. We also ensured that the contents truly reflected best practices in the area of *quality and productivity management for the* 80s, 90s, and beyond. We challenged ourselves to be forward looking and to force the reader also to focus on the future.

This guide reflects the contribution of many individuals and organizations. Many view it as a "living document," one that will continue to evolve and improve over time. We trust your organization will benefit from the knowledge and experience we have compiled. We encourage your feedback.

Appendix D

Index of Key Terms



Appendix E

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19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This document was developed to provide management teams and leaders in the aerospace and defense (A&D) contracting community with state-of-the-art information on quality and productivity management concepts, theories, strategies, and techniques. The document is the product of a five-phase, six-year study involving the A&D community's best, brightest, and most diverse group of A&D contractors, academicians, military service acquisition elements of the DoD, and the Defense Systems Management College faculty and staff. A simple, conceptual model around which the document is designed is used to facilitate understanding of the quality and productivity management process. The document begins with challenges facing the A&D contractor community. Next, the importance of the need for visions of the organization of the future are discussed. The document then turns to an innovative and effective way to strategically plan for performance improvement. A conceptual overview of present improvement strategies and techniques is presented, emphasis is placed on Total Quality Management, the management of participation, and gainsharing. Measurement issues, approaches, and techniques are presented. Reflections on continuous improvement and maintaining excellence end the document. An extensive bibliography and suggested readings are included to facilitate the reader's further study.

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